The TOOL ENGINEER

Official Publication of the
AMERICAN SOCIETY OF TOOL ENGINEERS

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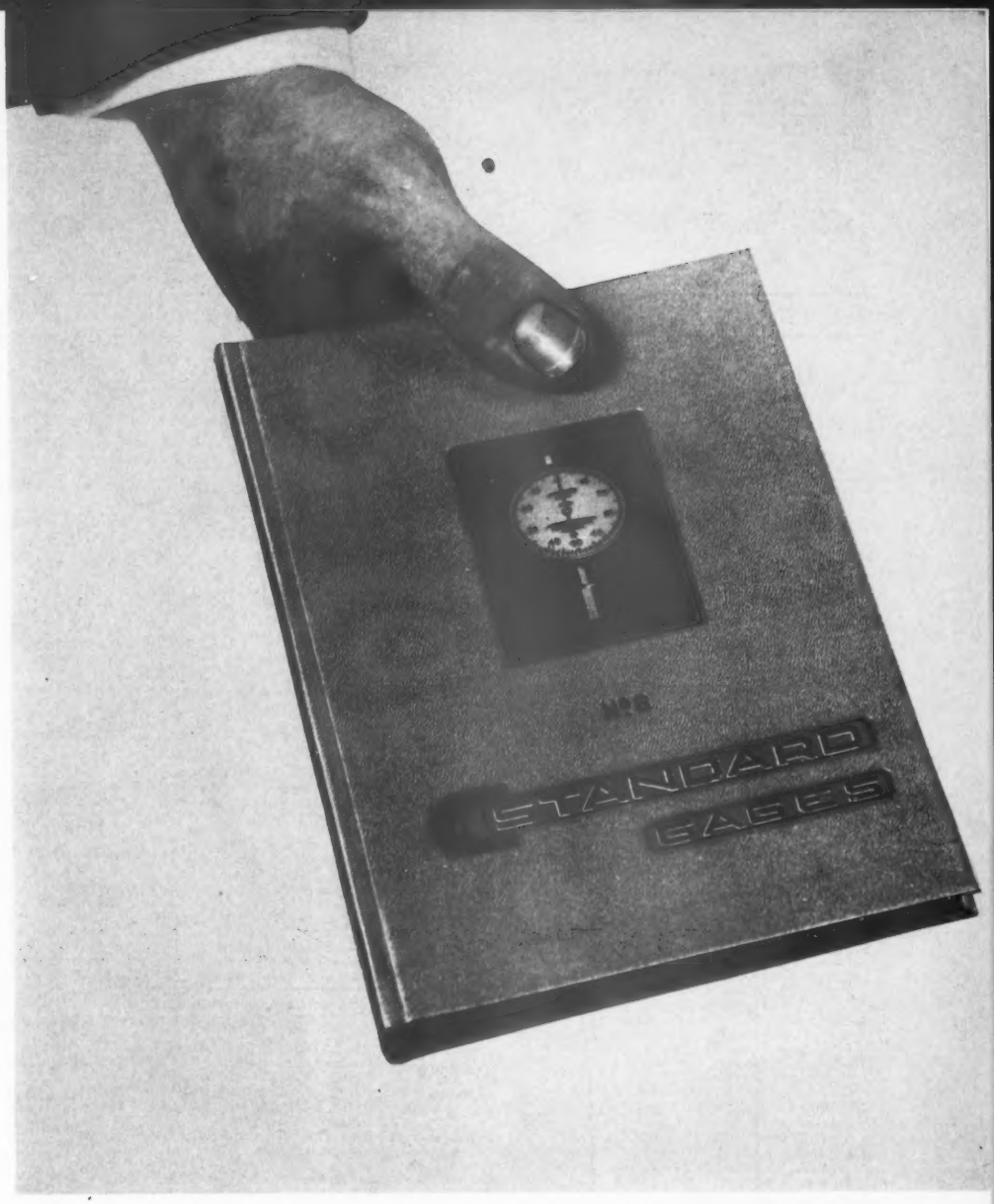

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Official Publication of the AMERICAN SOCIETY OF TOOL ENGINEERS

Vol. VIII FEBRUARY, 1940 No. 10

Contents

Application blanks and information pertaining to membership in the American Society of Tool Engineers may be had by addressing **The Tool Engineer**, 2842 W. Grand Boulevard, Detroit, Michigan, or the Secretary's office, 2567 W. Grand Blvd., Detroit, Michigan. **Dues are $5 initiation fee, $5 per year for senior grade membership and $3 per year for junior grade membership. Junior membership initiation fee $2.**

The Tool Engineer is published the first Thursday of each month. It is the official publication of the American Society of Tool Engineers, incorporated. The membership of the Society and readers of this publication are practical manufacturing executives such as master mechanics, works managers, Tool Engineers, tool designers and others who are responsible for production in mass manufacturing plants throughout the nation and in some foreign countries.

Published by

THE BRAMSON PUBLISHING CO.

2842 W. Grand Boulevard MAdison 7553 Detroit, Michigan

Roy T. Bramson, Publisher and Editor

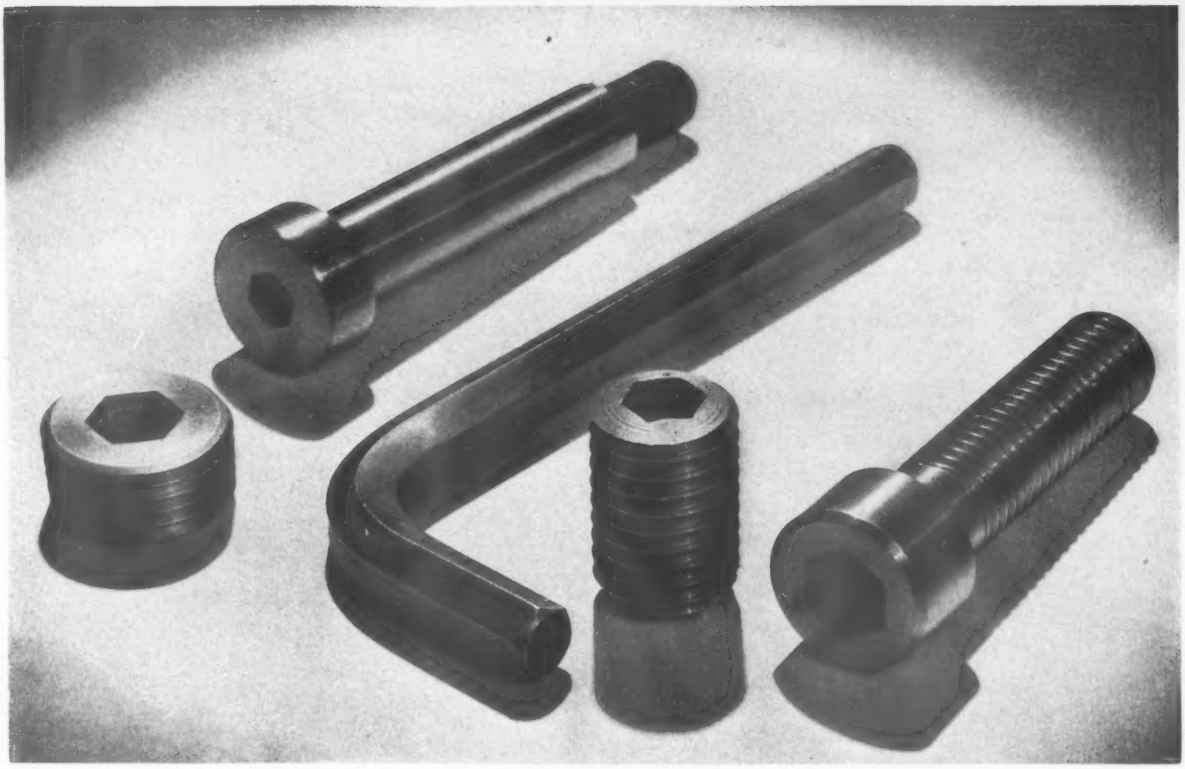
ADVERTISING OFFICES

Chicago, Illinois — Dwight H. Early, 100 N. LaSalle Street, CENtral 4156

New York City — A. M. Willcox, 420 Lexington Avenue, Lexington 2-4816

Providence, R. I. — Herman T. Pierik, 4 Weybosset Street, GAspee 1568

Printed in the United States of America



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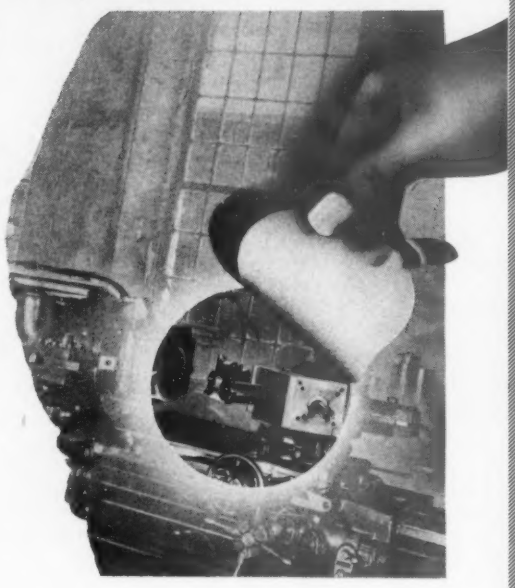

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A 20" x 30" four-color map to better tool performance. Tells at a glance how to get greater wear resistance, greater hardening accuracy and safety, greater toughness, or greater red-hardness from your tools. Opens the door to new toolroom savings—makes selection of the best tool steel for each job easy.

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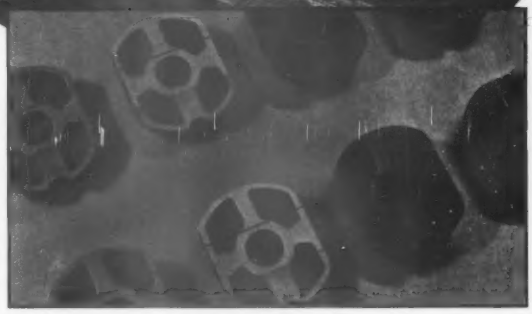

Quick Facts

Name of Part — Wringer Gear Housing Cover.

Material — Gray Cast Iron.

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Stock Removed — 5/32" x 3 1/32" x 3 7/8", (openings cored).

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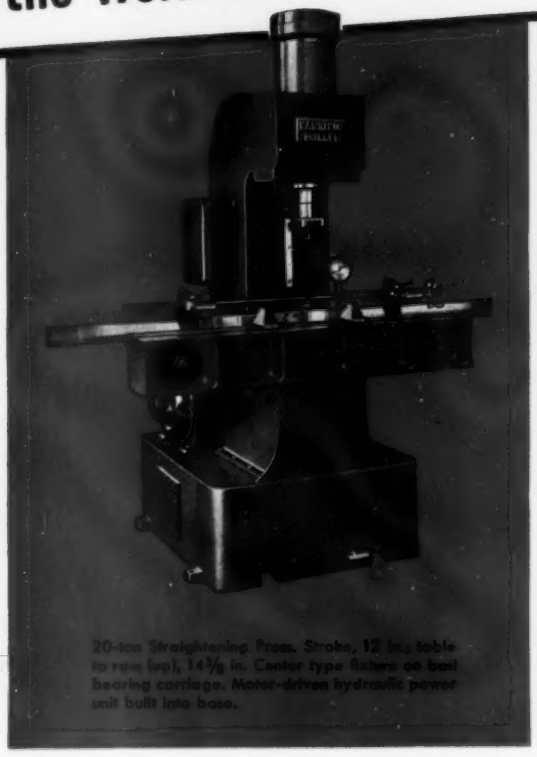

20-ton Straightening Press. Stroke, 12 in.; table to ram (up), 14⅜ in. Center type fixture on ball bearing carriage. Motor-driven hydraulic power unit built into base.

75-ton Straightening Press. Stroke, 24 in.; spring-mounted centers. Fixture and middle table section removable for pressing-in shafts and bushings, or similar operations. Motor-driven hydraulic power unit completely enclosed within press frame.

Hannifin Hydraulic Presses, equipped with the Infinitely Variable Pressure Control, give the operator complete and very sensitive control of ram pressures right at his finger tips. Any pressure required, from a few pounds to full capacity, is obtained by merely moving the control lever down. The farther the lever is moved the greater the ram pressure exerted on the work. Releasing the lever returns the ram to top position.

Hannifin Hydraulic Presses not only provide simple, easy handling that greatly increases production, but the increased ram stroke and greater clear distance from table to ram allow better view of the work. Rapid production is simplified, and improved accuracy in straightening operations can be consistently maintained.

The presses illustrated are but two of many Hannifin models available, in capacities from 20 tons to 75 tons, for straightening, pressing-in, and similar operations. Write for Bulletin 41, giving complete data. Hannifin engineers will make individual recommendations on receipt of your specifications.

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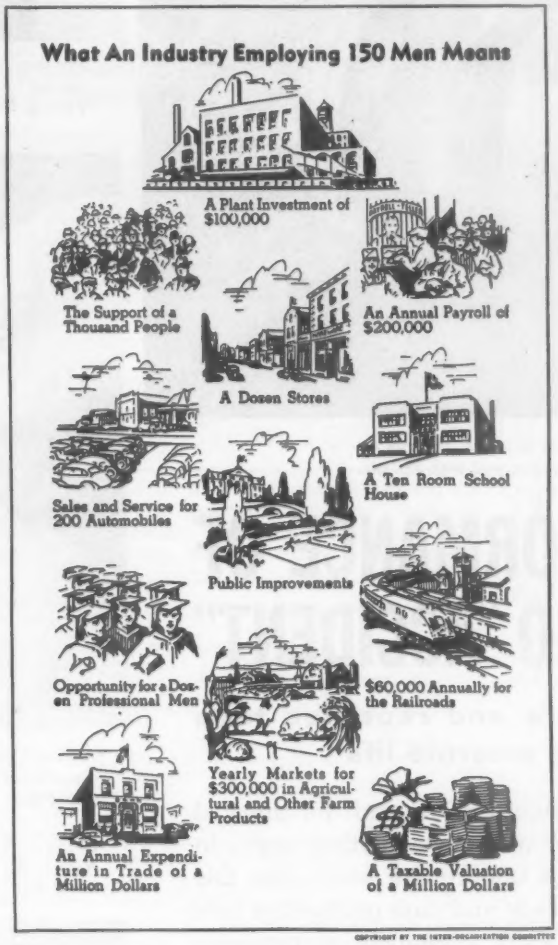
Invention and NATIONAL PROSPERITY

AN EDITORIAL

By A. E. RYLANDER

APPARENTLY falling in line with the anti-technologists, President Roosevelt is accredited with the rather astonishing statement that one problem before the country is to "find jobs faster than invention can take them away." This line of thought, implying that invention creates unemployment, has been authoritatively challenged by Mr. Prentiss, President of National Association of Manufacturers. In view of the facts, that invention has materially promoted, not decreased employment, and that this Journal and the American Society of Tool Engineers, through its Fact-Finding Committee, has indisputably established that tools and machinery have been vital factors in creating employment, an elaboration seems entirely in order.

Obviously, a factory reared in a vacant field, or on the site of an obsolete structure, and designed for the manufacture of a new or improved product, can have no other end than to provide employment. The structure alone draws on many fields—as forestry and mining in particular—and, in its conception, employs architects and surveyors among other white collar workers. Then, it gives work to various classes of artisans in the many industries which convert raw materials into finished building material. It provides employment for excavators and masons, steel workers and carpenters, roofers and glazers, men who, did not inventive genius broach new frontiers and private industry provide plants and equipment, would be on government relief or W.P.A. Thus, invention and industry conspire to nothing worse than providing gainful employment which relieves the government of support of the idle. It is entirely reasonable, then, that invention and industry should have the fullest support and encouragement from government and its administrative heads. Such is our belief.



Speaking for hard headed, practical men committed to industrial as well as social progress, the writer further holds that tools and machinery, designed to cut costs of manufacture, actually create employment for more workers than they displace. It is true that an automatic machine, enabling one man to do the work of ten, displaces nine. On the face of things, that is. But assume that an article, laboriously processed by hand, costs $100 to produce (of which, perhaps, $80 would be labor costs) and that this cost means a limited market. Hence, it is entirely probable that the demand, under the slower and costlier method, precludes employment for more than the original ten men.

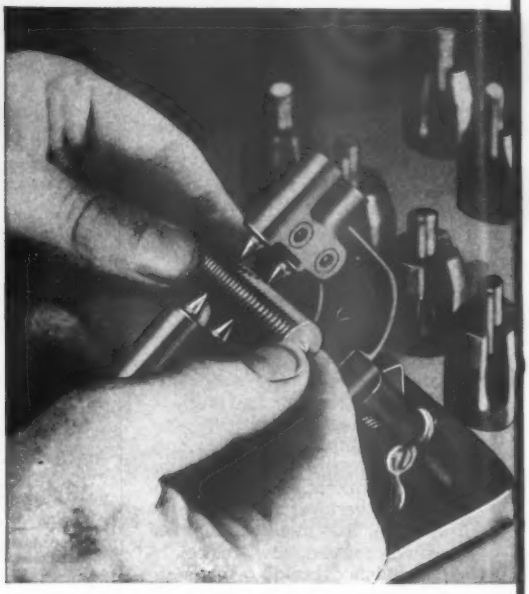
Now, assuming that ten articles can be produced at the cost of one, with an automatic machine (the making of which also provided employment), it follows that the market should expand with reduced production and selling costs. As invariably it does. That, if the article is one which lightens household drudgery—taking an off-hand example—the lower costs will create such demand that production increases a hundredfold and forces the manufacturer to expand plant, buy more equipment and employ more workers. Since this seems to be typical of invention, one is naturally surprised and puzzled that our Chief Executive should disparage invention.

We can take a typical and entirely factual case. While it is an open secret that automobiles improve in quality year by year, while costs are reduced, it may not be generally known how vital a part automatic tools and equipment play in improvement and cost reduction. One important phase in smooth engine operations, for example, is the perfect balancing of reciprocating parts, as pistons and "con" rods. The more precisely these are balanced, the smoother the engine will run and, consequently, the longer it will wear. Balancing reciprocating parts by hand is a slow and laborious process, so costly that heretofore it has been a feature of only the more expensive cars. But thanks to invention, there have been evolved tools which weigh piston assemblies, balance them to ultra-precision standards, then, in almost the same motion, remove surplus weight. Now, thanks to invention, Mr. Poorman gets the same smooth performance, in his car, that previously was enjoyed only by Mr. Richman. And Mr. Poorman, buying a quality car at a price he can afford (also thanks to invention), not only helps himself to a job but contributes to the employment of his fellows.

No, gentlemen, neither invention nor the machine are direct nor even indirect causes of unemployment. If that were true, then administrative heads of other nations enjoying a high state of technological advancement but who have materially reduced unemployment, would be equally quick to pass the buck. Of course, unemployment that affects some fourteen million potential workers is a vital problem, and one which must be solved lest we develop and foster a dependent class. It is so vital that the administrative genius of the nation can well devote full time to it until it is licked. But, to resolve it, we will have to be honest with ourselves, must honestly delve into it with open minds. And when the solution is presented, it will be found that invention, far from being a cause of unemployment, has been a factor in keeping employed those workers whose taxes now support the idle. As engineers, we exonerate the machine.

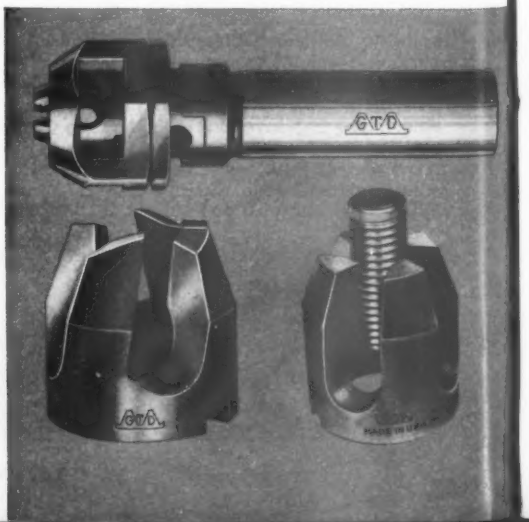
Each "Acorn" Die before final approval threads an actual test plug which is shipped to you with the die.

Too hard is as bad as too soft. Each heat-treated "Acorn" Die must pass this Rockwell Hardness Testing Machine.



Above: Limit snap thread gages check the pitch diameter of every "Acorn" Die test plug — 100% inspection.

Below: "Acorn" Die in regular holder.
Right: An "Acorn" Die with test plug inserted.
Left: An "Acorn" Hollow Mill.



AMAZING PERFORMANCE OF "ACORN" DIES NO "ACCIDENT"

How precision manufacture and repeated tests contribute to long accurate life

Super-accurate tools, such as "Acorn" Dies, call for unusual care in design and manufacture. Variation in cutting angle, in clearance, in chamfer — the least unevenness where the Die seats in the holder, destroys accuracy and cuts production to a fraction of what it should be. G. T. D. Greenfield supplements manufacturing care by thoroughly testing completed die. Some of the methods used to insure top performance are shown here.

It isn't the occasional record of an individual die that matters — it's the steady, consistent high production that "Acorn" Dies produce that makes them so favored by production men.

Greenfield Tap & Die Corporation · Greenfield, Mass.

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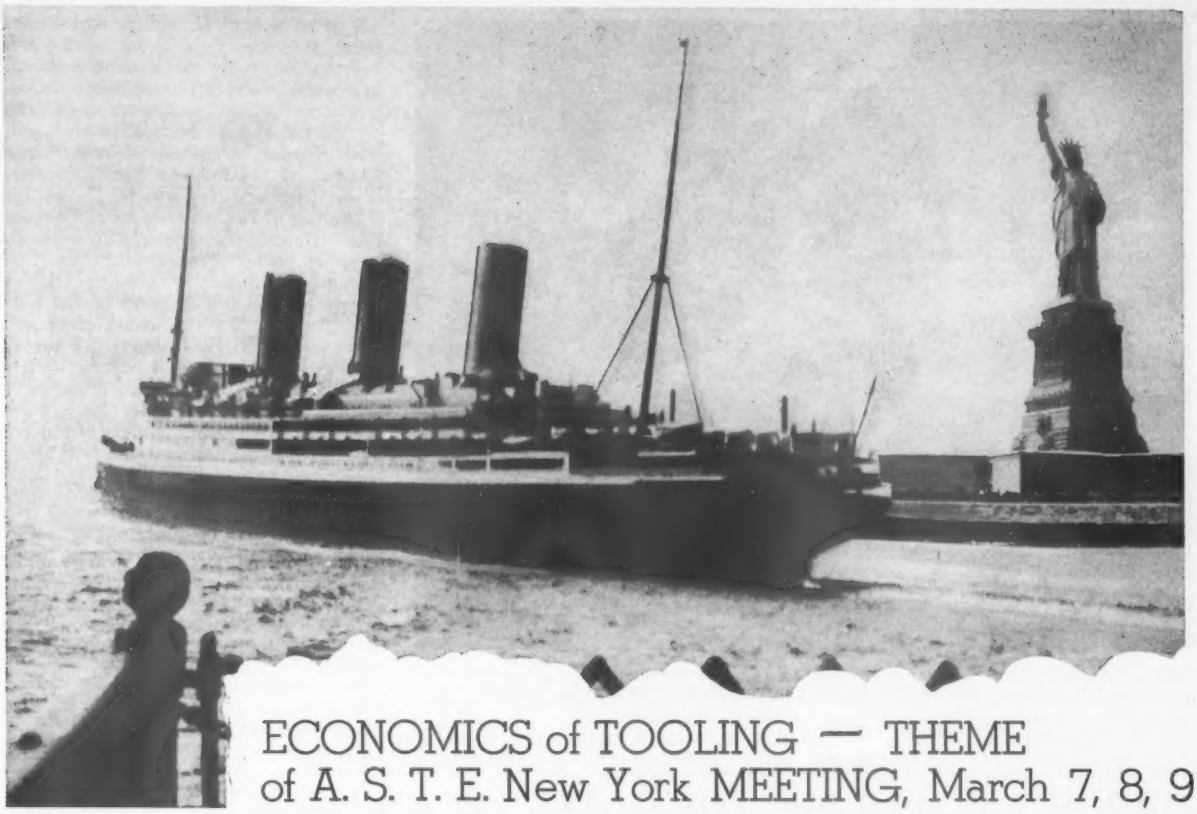


ECONOMICS of TOOLING — THEME of A. S. T. E. New York MEETING, March 7, 8, 9

THERE is not the slightest doubt about the 1940 A.S.T.E. meeting being the biggest, the most spectacular and to all purposes, the most ambitious, and the most educational gathering the young but progressive Society has yet presented for its members. No less than thirty speakers of national and international prominence have been engaged and have at this early date signified their intention of being present when Tool Engineers from all over the nation convene in New York City, March 7, 8 and 9.

Preliminary arrangements had been made to accommodate a thousand, now —arrangements are being consummated for many hundreds more in what is now looked upon as the bang-up meeting of the year for all mechanical executives who want to be primed with newest information and facts in the future of the nation's most important phases of industrial activity. "Education" oddly enough, at a time when mechanical information and data on the more effective manufacturing methods and processes is a crying need, is the central theme around which the entire three-day program is built. One look at the subjects to be discussed by speakers recognized as authorities, and later in forums for all to engage in, is all that is necessary to convince any one interested in tools and machinery, that he should be present when the opening session is called to order, Thursday morning at 10 o'clock, on March 7th.

Employers everywhere will recognize in the brief descriptions of the various symposiums and technical sessions, which follow, something of definite, tangible value to their manufacturing and shop executives—something they will not want their men to miss, because there is so plainly a "dollar and cents" value in every phase of industrial activity so completely covered in these sessions. Where else can Tool Engineers and technical men obtain information so valuable to key men in plants? Where else can these men have so excellent an opportunity to ask specific questions about their own problems—and, have them answered by authorities?

Being on the ground, brings also the opportunity to carry to completion, with questions and answers, those problems which have been bug-a-boos in every plant. Sessions like these promote the research and development approach in the shop man—a trait that should be encouraged. If you can beat these programs you're going some—here's your chance to really learn—in the most ambitious program any technical group has ever attempted along these lines.

NOTICE

The American Society of Tool Engineers, Inc., is not holding a show at Bridgeport, Connecticut this year and is in no way connected with any show which may be held at Bridgeport during 1940.

Published by order of the Board of Directors of American Society of Tool Engineers.

Economics of Tooling

This subject will be handled by well known speakers including—

B. G. Tang, General Superintendent, Schenectady Works, General Electric Company.

W. F. Stegemerten, Superintendent of Equipment Methods, Westinghouse Electric & Manufacturing Co., South Philadelphia Works.

J. M. Crawford, Assistant Superintendent, Generator and Motor Section, General Electric Company, Schenectady.

F. E. Darling, Wage Standards Department, Eastman Kodak Company Camera Works, Rochester, N. Y.

W. J. Peets, Assistant Superintendent,

Unusual departure in this year's A.S.T.E. convention is the complete separate program being planned for the interest of the ladies. Ample opportunity will be provided to see behind the scenes of some of the greatest sights in the world—including the world's largest department store, the world's largest radio facilities and others too numerous to mention.

View in a Todd Shipyards Corporation machine shop, showing tail shaft of a large steamer being turned in mammoth lathe. Mechanics shown are checking the taper of the huge shaft.

Singer Manufacturing Company, Elizabethport, New Jersey.

This symposium will cover the entire scope of production planning and will describe most successful methods of tooling large and small products—large and small quantities. Many executives have been concerned about the proper tool cost which will produce the maximum of economy in manufacturing under various conditions and this symposium is intended to develop a possible formula for arriving at an economic tool appropriation where other factors such as volume unit price, etc., are known.

Precision Small Gears

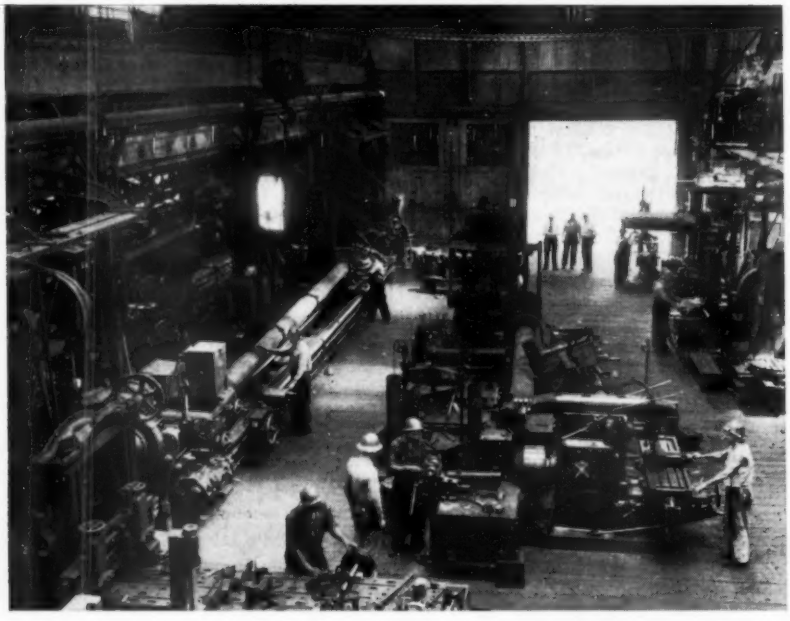
Equipment of foreign manufacture has been depended on, to a great extent to produce precision small gears. Interruption of the sources of this equipment, occasioned by the war, is forcing the development of this type of equipment at home. Few of us realize the magnitude of the development which has taken place in our domestic industry, and which has surpassed the equipment and methods formerly used. Tom Turner, Manager Westinghouse Electric & Manufacturing Company, Meter Division, Newark, N. J., George H. Sanborn, Representative of Fellows Gear Shaper Company, Springfield, Vermont, Arnold Thompson, Chief Designing Engineer, Canadian Acme Screw and Gear Company of Canada, Ltd., Toronto, Ontario, and a representative of the Barber-Colman Company, Rockford, Illinois, will throw much light on this subject. If you attend this session you will not only learn how precision small gears can be produced by shaping and hobbing, but will learn how they can be generated in automatic machines simultaneously with the blanking operations.

Tooling for Plastics

This newest of our industries bids fair to grow into one of our largest industries. More knowledge about tools and processes together with information on little known possibilities will greatly stimulate this industry. Speakers representing the pioneers in the development of the plastic industry will cover the subject. J. E. Stewart, Gen. Foreman, Plastics Division, Ford Motor Company, Dearborn, Michigan. W. B. Ross, DieMolding Company, Canastota, New York, and F. W. McIntyre of the Reed-Prentice Company, Worcester, Massachusetts, will not only tell what is being done but will tell some things that can't be done as well as some things that will be done.

MARCH 7, 8 and 9 ARE THE DATES - PLAN NOW TO ATTEND

Below is shown a view of the machine shop at Tietjen & Lang Dry Dock Company, Hoboken, N. J. The tail shaft of a large steamer is seen being placed in a large lathe—one of the many unusual operations to be inspected in New York's varied industries, by the visiting Tool Engineers.



Screw Machine Tooling

This little known subject, often left to the cleverness of the operator needs to be brought into the open. H. P. Berry, Editor "Screw Machine Engineering" and Senior Tool and Gage Designer, Naval Gun Factory, Washington, D. C., M. W. Taylor, Foreman, Screw Machine Department, Wright Aeronautical Corp., Paterson, N. J., C. G. Stevens, Mechanical Superintendent, New Departure Division, General Motors Corp., Bristol, Conn., L. G. Gilbert, Manager, Time and Methods Department, Columbus-McKinnon Chain Corporation, Tonawanda, N. Y., will cover all phases of this subject from the new system of calculating top rake on form tools to the latest set-ups for automatics, multiple spindle machines and turret lathes.

Punches and Dies

W. T. Forde, Manufacturing Supervisor, International Business Machines Corporation, Endicott, N. Y., Gordon L. Reed, Chief Engineer, York Corrugating Company, York, Pennsylvania, Frank D. O'Brien, Tool Department, Master Mechanic, Camera Works Eastman Kodak Company, Rochester, N. Y.

(Continued on page 44)

SELECTION and HARDENING of TOOL STEELS for PREVENTION of DAMAGE

By
HOWARD SCOTT
METALLURGICAL ENGINEER
WESTINGHOUSE RESEARCH LABORATORIES

THE Tool Engineer is vitally concerned with the hardening of steel. Most of the steel he uses is of the tool grade and consequently expensive. This grade is most easily damaged by hardening, in fact damage of some kind is seldom avoided in current hardening practice. Damage is expensive to correct if it can be corrected at all and when it escapes detection is revealed only by poor service performance. Accordingly, the Tool Engineer among all uses of steel has most to gain by refinements in hardening practice.

It is customary to place the blame for hardening damage on the tool hardener whose position on that account is not an enviable one. Such trouble is, however, due more to incomplete dissemination of recently acquired technical information on steels and hardening reaction than to any fault of the tool hardener. The savings to be gained by even modest improvements in tool and particularly die hardening practice are so great as to justify many papers which aim, as does this one, to treat the involved subject of tool steel selection and heat treatment from the viewpoint of the Tool Engineer. This can be done in a simple yet comprehensive manner.

Our primary consideration now is how to select with full regard to basic requirements the best type of tool steel and the best heat treatment for it. As a preliminary step in this direction, the major kinds of damage to tools which are likely to occur on hardening are classified as follows:

1—Damage at furnace temperature
- (a) Oxidation (scaling)
- (b) Decarburization
- (c) Warpage by sagging

2—Damage due to quenching operation
- (a) Cracking
- (b) Distortion
- (c) Incomplete hardening

Of the factors causing damage in the furnace, (c) can be eliminated simply by providing adequate support for the work. There remain, then, the twin miscreants, oxidation and decarburization. Fortunately very effective means for dealing with them are now available and are described in the following section of this article.

All three types of damage originating on quenching are subject to control, but only by selection of the steel composition and a quenching medium appropriate thereto. The steel selection is conditioned also by the physical properties required and by the size and shape of tool to be made, so steel selection considerations can become quite involved. It happens, however, that there are simple relations between steel properties, hardening characteristics and composition so the matter of composition and quenching medium selection can be easily expounded as is done here under the heading: "Selection of Quenching Liquid."

After considering the results of quenching in liquids we still find perfection unattained. Damage of a kind particularly objectionable in dies and complicated tools, namely distortion and cracking, is still likely to occur. This damage can be eliminated only by use of air-hardening steels and hardening them by cooling in a protective gas. It is not generally known that a wide variety of tool steels, including the most important varieties and some of moderate price, can be so hardened. These steels are identified in the concluding section of this paper and means described for hardening them in a practical manner with complete elimination of hardening damage.

Avoidance of Surface Damage

Combusted gas atmospheres are now widely used in hardening furnaces for the prevention of surface damage. The most commonly used gas is that produced by the partial exothermic combustion of natural or coke oven gas. Further reference to this type of gas will be made by the term exogas in order to avoid repetition of this clumsy descriptive phrase. Exogas affords adequate protection against oxidation to low alloy steels, but unless highly purified it does not offer acceptable protection against decarburization of highly alloyed steels. It is, nevertheless, a satisfactory medium for the heat treatment of low carbon and low alloy content steels.

Another combusted gas atmosphere has been developed to meet hardening requirements of high carbon and highly alloyed steels. A mixture is required which is so rich that the reaction becomes endothermic and heat must be supplied from an external source to maintain combustion. Such a gas, endogas for short, prevents decarburization even of the highly alloyed tool steels at the high hardening temperatures required.

The compositions of both gases so far described are not fixed, but can and

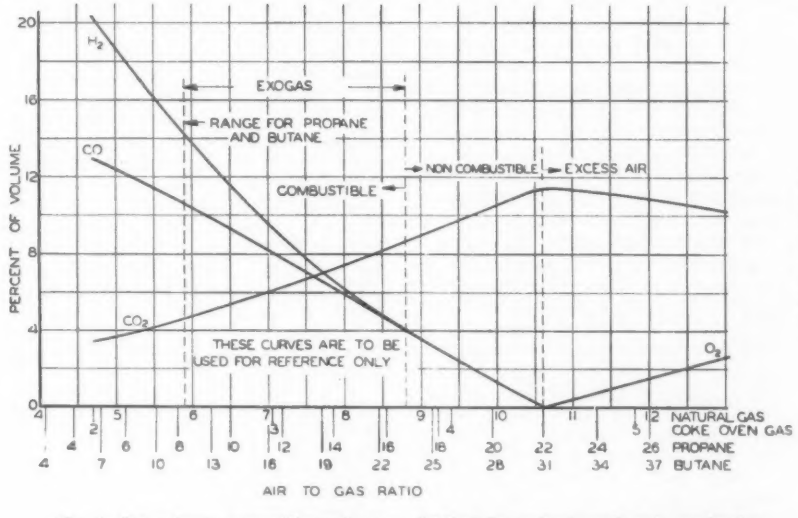


Fig. 1—Approximate compositions of gases obtained by natural exothermic combustion of standard fuel gases.

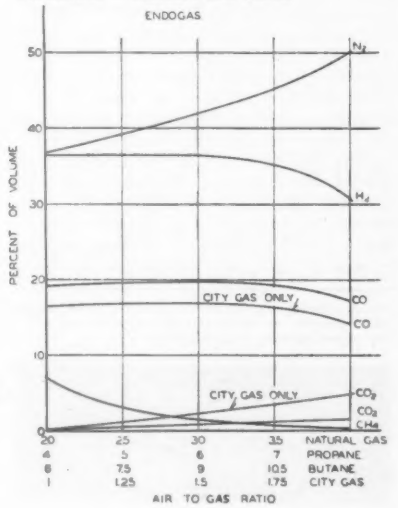
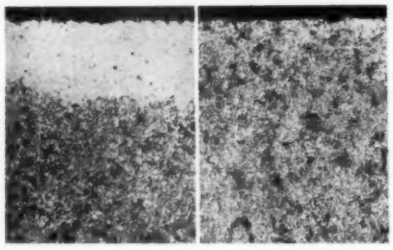


Fig. 2—Approximate compositions of gases obtained by externally supported endothermic combustion of standard fuel gases.

must be varied to suit the steel to be treated. How the major gas components vary with the air-gas ratio is shown in Figures 1 and 2. The content of the reducing gases CO and H_2 increases as the mixture becomes richer, that is, as the air-gas ratio diminishes. CO is also a carburizing gas so increase in its content tends to overcome the decarburizing action of oxidizing gases such as CO_2 and H_2O. The content of CO in exogas, Figure 1, is insufficient to prevent decarburization of the highly alloyed tool steels, but its content can be maintained sufficiently high in endogas, Figure 2, even to cause carburization. Comparative effects of these gases on the surface of high carbon steel are shown in Figure 3.



A B

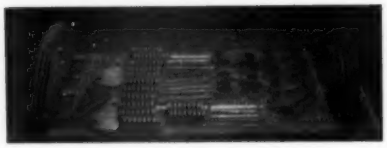
Fig. 3—Microsections through surface of S.A.E. 52100 steel after heating at 1500°F. for one hour in (a) Exogas and (b) Endogas. White area in (a) is decarburized skin absent in (b). Magnification 200 diameters.

The proper application of these gases is in fields where large quantities of a protective gas are required. Here gas cost becomes a vital factor and these gases are, of course, quite inexpensive. A representative application is to continuous hardening in a moving hearth furnace. Incidentally, the protective atmosphere performs a valuable service here in addition to combating surface damage. By virtue of the absence of scale, penetration and uniformity of hardening on oil quenching are greatly improved.

Endogas gives fully satisfactory protection to S.A.E. and tool steels, being well adapted to the hardening of quantity production items. Another gas, however, is better adapted to the requirements of expensive tools in small lots. This gas is a mixture of nitrogen and hydrogen derived from ammonia, called ammogas for brief identication.

The raw material for generating ammogas is available everywhere in convenient containers. Equipment for conversion is simple and easily maintained. No composition control is required. To preserve its good properties as generated, however, contamination must be scrupulously avoided. This requirement has been met by designing a furnace for the exclusive purpose of hardening expensive dies and tools. In it, ammogas is conveyed uncontaminated to the work surface. Description of this novel furnace is deferred to the last section.

Fig. 4—Photograph of stainless steel springs and other articles as hardened by heating and cooling in an ammogas atmosphere.



Ammogas is so highly reducing that even the extremely reactive stainless steels can be hardened in it without tarnish. A photograph of springs and other articles so hardened is shown in Fig. 4. Its composition does not need to be modified with change in steel composition, though the addition of a carburizing gas should be made when extremely fine work is to be hardened and is easily done. Ammogas costs more than combusted gases per cubic foot, but consumption of it is very small because of the extreme precautions taken to avoid contamination. For this reason gas cost is a negligible factor in the hardening cost equation.

It is now clear that the trade has at its command three types of protective gases, each having its own particular field of application. One or another of them will meet practically every requirement of heat treatment. From the Tool Engineer's viewpoint, however, ammogas is most important because of his extensive use of a wide variety of highly alloyed tool steels requiring maximum care in hardening. By proper use it enables the steel hardener to achieve that long sought objective: Trouble-Free Hardening, further details of which are given in the last section of this paper.

Selection of Quenching Liquids

There is a current notion that each branch of tool production, namely design, steel selection, machining, and heat treatment, can be handled by separate non-communicating departments. Actually, however, when the form of a die or other tool is drawn and its service requirements specified, selection of a steel composition and treatment has already been restricted to a narrow range. Thus the tool designer's failure to consider any one of the elements entering into the production of a complicated tool is likely to introduce failure in some step of its manufacture or in service.

Hardening failures can at once be minimized by recognizing that there are three accepted and highly effective quenching media each of which is properly used only with a particular distinctive type of steel. In fact the relation between quenching medium and steel composition is so close that it is commonplace to distinguish these three classes of steels by the quenching media appropriate thereto, namely, water, oil and air. Use of the wrong media may result in cracking, excessive distortion or failure to harden. If, despite the use of an improper medium, hardening is successful, the use of a more expensive steel than necessary is indicated.

The selection of a quenching medium and consequently of the type of steel used is determined by the characteristics of the several quenching media. Water is the fastest practicable quenching medium while air is relatively very slow. Oil is intermediate in cooling activity, but is closer to water than to air. The slower the cooling medium, the more alloy content is required in the steel to be hardened, hence the more expensive it is likely to be. Thus the plain carbon steels which can only be hardened effectively in large sizes by a water quench are the least expensive. Their use is indicated, therefore, wherever their properties permit.

Carbon and other water hardening steels yield as high hardness as alloy steels and are much easier to machine. Their mechanical properties in moderate and large sections are good when properly hardened. They lack, however, heat resistance, a property required in high-speed cutting operations and, to a lesser degree, wear resistance. Still, when these properties are not required there remain many shapes in which they cannot be used because of the extremely fast cooling required to harden them.

Excessively high temperature gradients are necessary to produce fast cooling such as is required for hardening carbon steels and these gradients are the unavoidable cause of distortion and cracking in water hardening steels. Simple or heavy shapes and even rather complicated symmetrical shapes can nevertheless be water hardened with satisfaction. Peculiarly, cracking is not a serious problem, at least in fine grained steels when no section is so thin as to harden to the center. Distortion, of course, is high relative to what can be obtained with the other media, but can be kept to reasonable limits by avoidance of slender parts and great care in quenching practice. Within this roughly indicated field, water hardening steels can be used with highly satisfactory results, but an excursion beyond the boundary in search of economy is likely to be expensive.

Successful use of water hardening steels entails careful attention to details in hardening. Individual piece hardening is essential for tools. The work must be so introduced into the quenching tank that water flow past all faces is equalized. Any circulation in the tank must be symmetrical with the work contour. Perhaps the most difficult trouble to avoid is soft spots, particularly in fine grained steels. Soft spots are usually under 40 Rc when 60 Rc or better is expected. Their occurrence can be practically eliminated, however, by use of a brine quench with proper maintenance.

In a paper presented at the Annual Convention of the American Society for Metals, Trembour and Scott describe in detail the factors essential in water-base quenching liquids to secure uniform and dependable hardening without vigorous agitation, a factor favorable

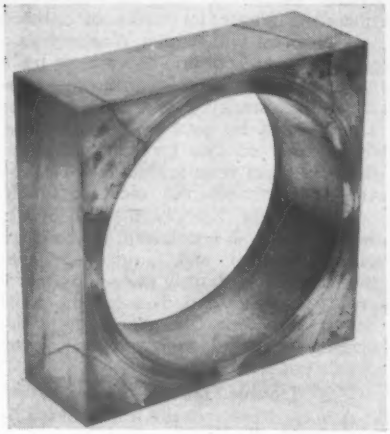


Fig. 5—Photograph of dimensional change test specimen cracked on normal oil quenching.

to distortion. It is shown that ordinary tap water is quite unsatisfactory, especially when heated slightly as it is necessarily when work is quenched.

Water, nevertheless, becomes a very effective quenching medium, even though not agitated, by adding certain soluble compounds. Common salt and sodium hydroxide are the best among many studied and are quite widely used in practice. Their concentrations, however, are rather critical, namely, 9 and 3 per cent by weight respectively, and there is little to choose between them at these concentrations. Other solutes may be decidedly harmful as is soap, a small quantity of which will counteract the beneficial effect of a salt addition to water.

Obviously carbon steels meet only a small fraction of the Tool Engineer's requirements. Low cost steels which

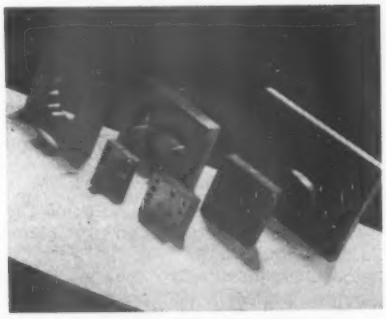


Fig. 8—Photograph of dies as hardened by heating and cooling in the ammogas atmosphere furnace.

can be hardened in complicated or unsymmetrical shapes without severe distortion are required for applications where heat resistance and maximum wear resistance are unnecessary. The oil hardening steels serve this field very well. Although the cooling power of oil is not much below that of water, the temperature gradients produced are materially less as is distortion. Carbon steels cannot, of course, be hardened in oil except in thin sections, for example blades under 0.10 inch thick. Steels having a moderate content of effective

Fig. 6—Photograph of laboratory furnace for bright hardening of dies in an ammogas atmosphere.

Fig. 7—Photograph of Westinghouse Ammogas Die Hardening Furnace.

elements such as chromium, manganese and nickel must, therefore, be used for work in which there is a distortion hazard which can be met by oil quenching.

Unlike aqueous quenching media, the composition of oils is not particularly critical. Any standard quenching oil offered by the trade is satisfactory though if the ultimate in performance is required, a quenching power test is needed to secure the best oil in this respect. Oil also differs from water in another manner. It can be used warm to advantage in lowering residual stress and consequently the danger of cracking without harm to its quenching power.

Another contrast between oil and water quenching is furnished by the effects of scale on their quenching actions. Scale on work interferes little with the quenching action of water because it usually flakes off instantly on contact with the bath. Such is not the case with an oil quenching bath, however, scale reducing materially its cooling effect on the underlying metal. Thus the use of a protective atmosphere furnace is indicated for the hardening of oil hardening steels.

Although oil quenching reduces materially the danger of warpage and distortion, it provides no assurance against cracking. In fact oil quenching of oil hardening tool steels presents more danger of cracking than water quenching of shapes suitable for water hardening which are made from a water-hardening steel. Figure 5 is an example of a simple shape made from a high quality tool steel which cracked badly after a normal oil quench. Actually it is often necessary to quench in warm oil or to

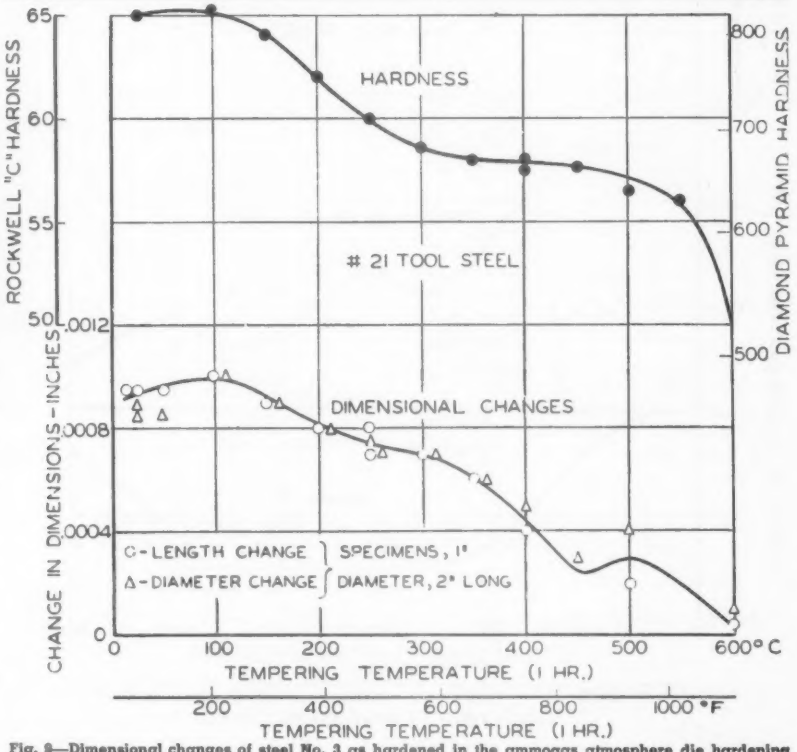


Fig. 9—Dimensional changes of steel No. 3 as hardened in the ammogas atmosphere die hardening furnace.

TABLE I

Nominal Compositions of Several Types of Tool Steels Which Are Amenable to Hardening by Gas Cooling. Solid Plates at Least 1 Inch Thick and Cylinders 2 Inches in Diameter Can Be Hardened to the Values Given Without Grain Coarsening from Temperatures Under 2100°F.

Steel Type	Comp. No.	% C	% Cr	% Mo	% X	% Y	Maximum Hardness Rc	Maximum Hardness DPH	Limiting Thickness of Solid Bar 6" wide*
High carbon, high chromium	(1)	1.5	12	1	0.2 V		64	797	3 in.
High carbon, high chromium	(2)	2.2	12	1	0.3 V		64	797	1 in.**
Intermediate Alloy	(3)	1.0	5	1	0.3 V		64	797	2 in.
Intermediate Alloy	(4)	0.6	4	0.6	0.5 V		58	668	1 in.**
Intermediate Alloy	(5)	0.4	5	1.0	0.4 V		55	610	1 in.**
Chrom-tungsten	(6)	0.40	5		0.3 V	4 W	58	668	1 in.**
Chrom-tungsten	(7)	0.35	5	1.7		1.5 W	56	630	1 in.**
Chrom-tungsten	(8)	0.5	3.5			13 W	58	668	1 in.**
Chrom-nickel	(9)	0.5	7	0.7	1.5 Ni	1.2 Mn	60	708	1 in.**
Chrom-nickel	(10)	0.4	2.2		2.6 Ni	0.3 Mn	54	592	1 in.**
Stainless	(11)	0.35	13				53	575	1 in.**
Stainless	(12)	0.7	17				55	610	1 in.**

* Larger sections can, of course, be hardened if not solid.
** A minimum value, most compositions being hardenable in thicker sections.

remove the work from the oil before it becomes cold to prevent cracking. This fact means that oil quenched articles contain high residual stresses even though not quite high enough to cause cracking. Residual stresses are, of course, lowered by tempering, but the hardness requirements of tools seldom permit much reduction so oil hardened tool steels have to support residual as well as service stresses.

The need for the full hardness inherent in a tool steel together with reduction of residual stresses to inappreciable magnitude and elimination of distortion and other forms of damage is a problem with which Westinghouse research and Tool Engineers have been grappling for years. Realizing that freedom from cracking and high residual stresses can be secured only by relatively slow cooling for hardening and that the most wear-resistant tool steels are air-hardened, the most favorable conditions for hardening such steels were sought. A successful combination of atmosphere and equipment was found and thoroughly tested by hardening punches and dies for the most severe punching operations. It is described in the following and last section of this paper.

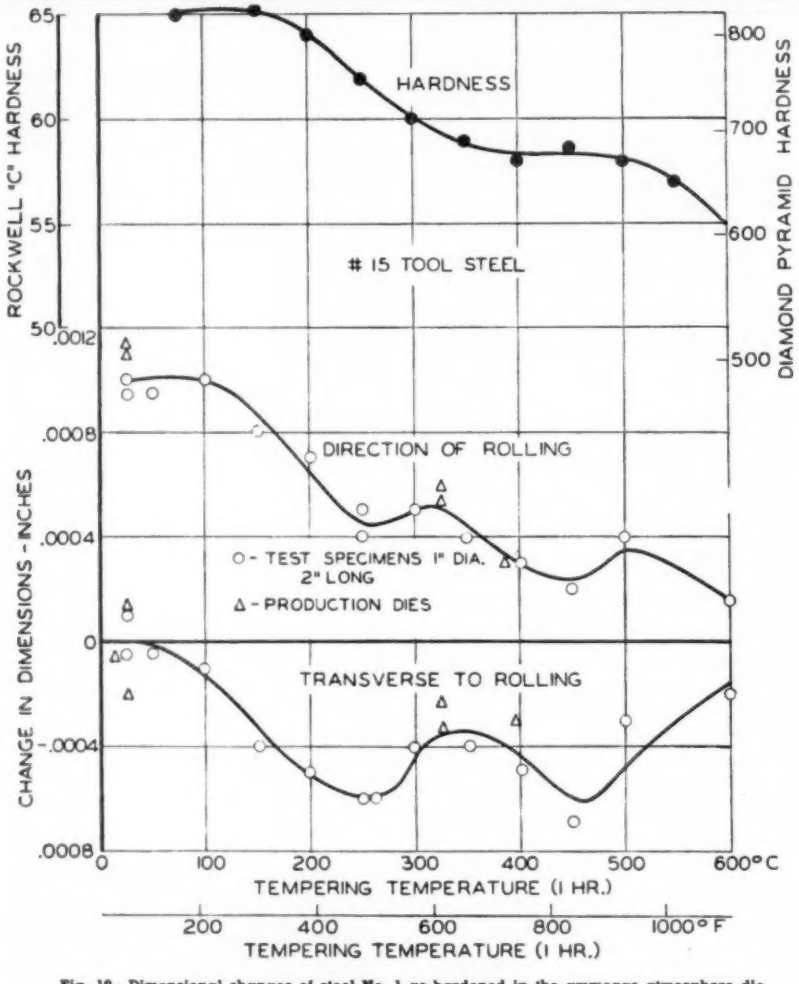


Fig. 10—Dimensional changes of steel No. 1 as hardened in the ammogas atmosphere die hardening furnace.

Trouble-Free Hardening

A wide variety of die and tool steels will meet the basic requirement for trouble-free hardening, namely that they harden fully in useful sizes on cooling in air or other gas from a temperature which does not produce grain coarsening. Typical compositions of such steels are given in Table I together with some information on their hardening characteristics. High-speed steels also fall in this category, but are not included in the table because the available equipment meeting all requirements specified here does not have a temperature range permitting development in them of full heat resistance, that is, red hardness.

The gas hardening steels described usually contain more alloy content than oil-hardening steels, but some are still within the price range of oil-hardening steels and one at least has better machinability than a competitive oil-hardening steel. Because of their high alloy content, most require a relatively high hardening temperature at which decarburization occurs at a very rapid rate. Consequently their protection against decarburization as well as oxidation is more difficult than that of lower alloy steels.

The exacting requirements of gas-hardening steels with regard to oxidation and decarburization are best met by an ammogas atmosphere for reasons already given. There is, however, one very important consideration in its use, namely that it be delivered unimpaired to the work surface. Research work has shown that destructive changes in gas composition easily occur between entry of the gas and its contact with the work surface. Special equipment and technique, therefore, is required to prevent damaging changes in the gas. Though both the equipment and procedure required is different and therefore looks formidable in contrast with a conventional background, furnace construction is simple and its operation quite easy.

Figure 6 is a photograph of a furnace developed by Gier and Scott of the Westinghouse Research Laboratories for the exclusive purpose of hardening high cost dies and tools without damage. It is described in detail in a paper presented at the annual convention of

(Continued on Page 50)

MACHINING WITH SINGLE POINT TOOLS

PART 2*

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• • •

Condensed from three lectures by the author delivered before the Educational Committee of the Cincinnati Chapter of the American Society of Tool Engineers.

Cutting Speed and Work Diameter

The relationship between cutting speed, work diameter and spindle revolutions per minute is expressed by the following formula:

$$v = \frac{D \cdot \pi \cdot n}{12} \text{ ft./min.} \qquad (4)$$

where: v = cutting speed ft./min.
D = diameter of work (in.)
n = spindle revolutions per minute.

A diagram representing this relationship can conveniently be drawn by chosing a diameter of 3.81" as the "marking line" for the r.p.m. on bilogarithmic paper. In this case:

$$v = \frac{3.81 \cdot \pi \cdot n}{12} = \frac{12 \cdot n}{12} = n$$

Thus, for this particular diam., the cutting speed is numerically equal to the r.p.m. Hence it is only necessary to mark the values of the r.p.m. on the line representing a diameter of 3.81" and to draw through these points a series of lines ascending at 45 degrees. This arrangement is shown on Diagram 5 which refers to a lathe having the following r.p.m.: 17 — 23.6 — 33.5 — 47.5 — 67 — 95 — 115 — 159 — 225 — 321 — 450 — 645.

Example: To determine the r.p.m. for a work diameter of D = 2", if a cutting speed of v = 60 ft./min. is wanted.
Result: (See arrows on Diagram 5): n = 115 r.p.m.

It will be seen from Diagram 5 that the inclined lines representing the r.p.m. of the lathe are evenly spaced except between n = 95 and n = 115 where the distance is smaller. Equal distances between such lines indicate a geometrical progression of the r.p.m., while a smaller or a larger distance indicates a deviation therefrom. Thus diagrams of this type serve also for judging the design of a lathe as far as the correct geometrical progression of the spindle revolutions is concerned.

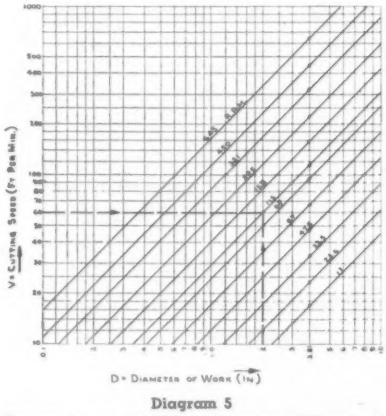

Diagram 5
Diagram for relationship between diameter of work (D), R.P.M. and cutting speed (V).

Angles for High Speed Steel Tools

The following table is a suggestion for standardizing numerical values for tool angles which should be used unless special circumstances call for changes. The terminology used corresponds to American Standard A.S.A. B 5.13 — 1939.

True Rake Angle	Lip Angle	Working Relief Angle	Used for:
0°	84°	6°	Chilled cast iron: Brittle or hard brass and bronze
8°	74°	8°	Steel and Cast Steel with more than 100,000 lbs./sq. in. tensile strength; cast-iron over 200 Brinell. Brass, Bronze, Cast Bronze
14°	68°	8°	Steel and Cast Steel 70-100,000 lbs./sq. in. tensile strength. Cast iron with less than 200 Brinell; Soft Brass
20°	62°	8°	Steel and Cast Steel 50-70,000 lbs./sq. in. tensile strength
27°	55°	8°	Tough and soft bronze and steel below 50,000 lbs./sq. in. tensile strength
40°	40°	10°	Light Alloys

Cutting Force as a Function of Chip Cross Sectional Area

As in the case of cutting speeds, values for the cutting force have been determined, but here again the limits are wide. Careful tests[3], however, show that the main variable upon which the cutting force depends, is again the chip cross sectional area A. It has been found, that the specific pressure as well as the total force give straight lines on a bilogarithmical paper as functions of the chip cross sectional area. Thus it is possible to derive equations which can be used easily. The formula for the specific cutting pressure is:

$$p = \frac{C_p \cdot 1000}{\sqrt[E_p]{1000\,A}} \text{ lbs./sq. inch}$$

where: C_p = a constant depending on the material to be cut and the rake angle of tool.
E_p = exponent depending upon the material to be cut.
A = chip cross sectional area (sq. in.)
p = specific cutting pressure (lbs./sq. inch).

The specific cutting pressure is not a constant, as often assumed, but decreases with increasing chip cross sectional area and is furthermore influenced by the material to be cut and by the true rake angle of the tool, which is taken into account in determining C_p. In addition the sharpness and finish of the tool-face, the particular cutting fluid used, and other factors, affect the cutting force to an extent which is not yet fully known. Due to the fact that the cutting force usually oscillates, the formula gives average values between the highest and lowest points of the oscillating cutting force curve. It has been found[5] that C_p is a function of the square root of the product of the tensile strength of the material to be cut, and the lip angle of the tool, within the limits of angles commonly used. Cutting force values obtained by different investigators only show satisfactory agreement if both the tensile strength and the lip angles are taken into consideration.

Tables IV and V give the C_p values for steel and cast iron. Table VI gives the value of C_p for some other materials. The true rake angle in these tables is understood to be the rake angle in the direction of the flow of the chip (i.e., approximately perpendicular to the main cutting edge).

The cutting force F follows the law:

$$F = C_p \cdot (1000\,A)^r \qquad (5)$$

where: $r = 1 - \frac{1}{E_p}$

At first sight formula (5) appears to be too complicated for use in practice, but in reality it is very simple to calculate the cutting force if the multiplication factors from Table VII are used.

* Continued from page 16, "The Tool Engineer," January 1940.

Thus, for calculating the cutting force it is only necessary to multiply the value of C_p taken from Tables IV, V or VI by the value from Table VII.

Example: Required the cutting force for turning S.A.E. 1035, true rake angle of the tool 20°, chip cross sectional area A = 0.01 sq. inch.
Procedure: From Table IV: $C_p = 408$
From Table VII: Multiplication factor = 6.4.
Therefore cutting force
$F = 408 \times 6.4 = 2610$ lbs.

It will be observed from Table VII that the cutting force does not increase in proportion to chip area, but at a lower rate. For example, the cutting force for A = 0.04 square inch and under the same conditions as given above, amounts to: $408 \times 19.3 = 7875$ lbs. This is approximately three times the value of the cutting force of 2610 lbs., although the chip cross sectional area has been quadrupled from A = .010 square inch to A = .04 square inch.

Cutting Pressure As a Function of Depth of Cut and Feed/Rev

As in the case of the cutting speed, it is sometimes held that it does not suffice to specify the cutting force as a function of the chip cross sectional area, but that allowances must be made also for its shape. Under this consideration the cutting force law is often presented in the following general form:

$$F = C\, d^x\, f^y \quad \text{(depth of cut and feed formula)} \qquad (6)$$

where: F = Cutting force (lbs.)
C = Constant of material to be cut
d = Depth of cut (inches)
f = Feed (per rev.) (inches)
x, y = Exponents

Such a formula can, however, always be transformed into:

$$F = C \cdot A^{\frac{1}{2}(y+x)}\, S^{\frac{1}{2}(y-x)} \quad \left\{\begin{matrix}\text{area and}\\ \text{shape}\\ \text{formula}\end{matrix}\right\} \qquad (7)$$

where: A = chip cross sectional area = f · d
S = shape factor of chip (or ratio of feed to depth of cut) $= \frac{f}{d}$

It indicates—as in the case of the cutting speed—that the chip cross sectional area A is of a considerably greater effect on cutting pressure than the shape of the chip.

Taking as an example the cutting force formula for turning steel, which was developed by F. W. Taylor, we have:

$$F = C \cdot d \cdot f^{0.934}$$

which, by the above transformation becomes

$$F = C \cdot A^{0.967} \cdot S^{-0.035}$$

The effect of a change in the shape-factor S on the cutting force can thus be calculated. It will be seen that such a big change as 1:10 viz: from S = ½ to S = 1/20 results in an increase of the cutting force of only 7½ per cent. A change in the chip cross sectional area of 1:10 results, however, in 830 per cent increase of the cutting forcel

TABLE IV

C_p Values for Steel

True rake angle	Material S.A.E. 1015	S.A.E. 1025	S.A.E. 1035	S.A.E. 1045	S.A.E. 1060
35°	270	312	358	406	473
30°	284	328	375	426	496
25°	296	342	391	445	516
20°	308	357	**408**	464	538
15°	320	370	424	481	560
10°	330	383	439	498	579

TABLE V

C_p Values for Cast-Iron

True rake angle	Brinell Hardness 100	120	140	160	180	200
35°	92	98	105	111	116	121
30°	97	104	112	118	124	128
25°	103	110	118	125	131	136
20°	108	116	125	132	138	143
15°	113	122	131	139	144	150
10°	119	127	137	145	151	157

As will be evident from the comparison of 830 per cent change in cutting force as against 7½ per cent, the influence of the cross-sectional shape has been considerably overrated.

With the development of devices for measuring the cutting pressure since Taylor, it was found that the effect of the shape of the chip is practically without importance.[3]

Cutting Force and Work-Piece

The cutting force should be kept within certain limits in order to prevent too great deflections of the work.

Determining these limits involves complex problems. An approach shall however be made hereafter towards this aim for the case of turning between centers. It is not yet possible to do the same for turning of workpieces clamped in chucks or on face plates.

F. W. Taylor stated that the length of the work should not exceed 12 times its diameter. However, he did not consider the cutting forces involved. A relationship between the permissible cutting force and the dimensions of the work

TABLE VI

C_p Values for Other Materials

Material	True Rake Angle	Brinell	C_p
Cast Steel	18°	135-150	268
Light Alloy	40°	53	35
Brass	21°	Composition: 85%Cn, 9%Sn, 6%Zn	

TABLE VII

Multiplication Factors for Calculation of Cutting Force

A: $\left(1 - \frac{1}{E_p}\right)$ (1000A)

Chip-cross-sectional Area (sq. in.)	Multiply "C_p" (Tables IV, V, VI) to the following metals by: Steel	Cast Iron	Cast Steel	Brass	Light Alloy
.001	1.00	1.00	1.00	1.00	1.00
.002	1.75	1.80	1.80	1.68	1.92
.003	2.4	2.6	2.55	2.28	2.82
.004	3.1	3.3	3.25	2.83	3.70
.005	3.6	4.0	3.9	3.35	4.55
.008	5.3	6.0	5.9	4.8	7.1
.010	**6.4**	7.3	7.1	5.6	8.7
.015	8.8	10.4	10.0	7.6	12.8
.020	11.2	13.3	12.7	9.4	16.6
.025	13.3	16.0	15.4	11.2	20.5
.030	15.2	19.0	18.0	12.8	24.5
.040	19.3	24.4	23.0	15.7	32.0

can be established by considering the workpiece as a beam on two supports. The greatest deflection of the "beam" will occur if the tool is cutting at a point just half way between the centers. A workpiece between centers does not correspond exactly to either a rigidly clamped beam or to a hinged one, but the following formula may be used if an average condition is assumed:

$$F_p = \frac{6 \cdot K \cdot W}{L}$$

where: F_p = permissible force (lbs.)
K = a constant of the material to be cut (7000 lbs./sq. inch).
W = Modulus of section (in.³).
L = length between centers (in.).
D = diameter of work.

By substitution of the modulus of sec-

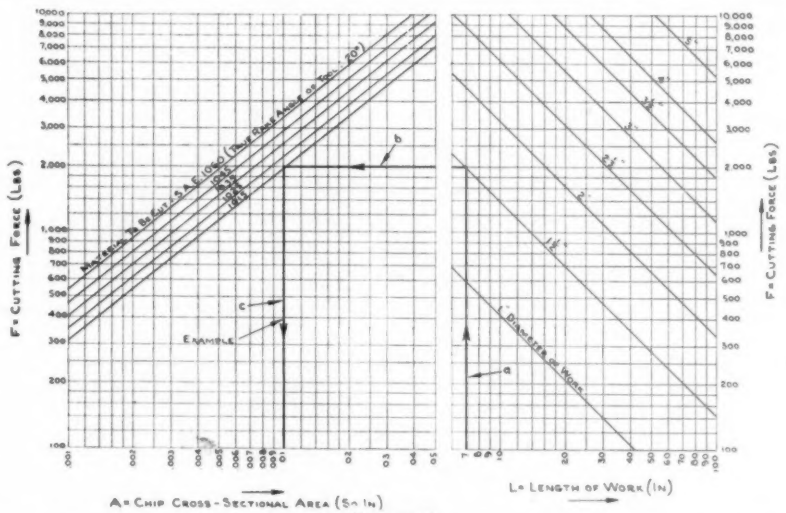

Diagram 6
The "LDFA" diagram: Giving relationship between length of work (L), diameter of work (D), cutting force (F) and chip cross-sectional area (A).

tion:

$$F_p = \frac{4200\ D^3}{L} \qquad (8)$$

It will be seen from formula (8) that the permissible cutting force increases as the third power of the diameter of the work. Formula (8) which determines the permissible cutting force must be correlated now with formula (5) which determines the generated cutting force. This can be achieved most conveniently by means of a bilogarithmical diagram, such as shown in Diagram 6, consisting of two parts. The left hand of Diagram 6 represents the relationship between chip cross sectional area, A, and the generated cutting force, F, for different materials according to formula (5). The right hand of Diagram 6 represents the relationship between diameter of work, length of work, and permissible cutting force according to formula (8).

Example: To determine the chip cross sectional area, A, for turning a work piece of L = 7" length between centers and a diameter of D = 1½"; material S.A.E. 1015; a steady rest cannot be used.

By following arrows, a—b—c, it will be seen that the chip-cross sectional area, A, for this case should not exceed .01 square inch.

Diagram 6 can also be used for calculating the distances at which steady rests should be spaced with a given cross sectional area of chip. In this case the sequence on the diagram is reversed, namely, following the lines, c—b—a.

The effect of the cutting pressure on the deflection of the lathe is complex and its calculation involves derivation of moments of inertia for various sections of the lathe and consideration of the load on the teeth of the gears. Investigations revealed that it is not always necessary to increase the wall thickness of the lathe for avoiding deflection and vibration, but that a proper distribution of the material often permits an increased rigidity, sometimes even with a decrease in wall thickness.

Productivity Diagram for Selecting the Most Effective Combination of Cutting Variables

The turning time, t, for a given piece is in general:

$$t = \frac{L \cdot z}{f \cdot n} = \frac{L \cdot z \cdot d \cdot D \cdot \pi}{12 \cdot A \cdot v} = \frac{L \cdot D \cdot K \cdot \pi}{12 \cdot A \cdot v} \text{ min.}$$

where: A = chip cross sectional area (in.²) $= f \cdot d$

D = diameter of work-piece (in.)

d = depth of cut (in.)

f = feed/rev. (in.)

K = stock to be removed on radius (in.)

L = turning length (in.)

n = rev./min.

v = cutting speed (ft./min.) $= \frac{D \cdot \pi \cdot n}{12}$

z = number of cuts $= \frac{K}{d}$

For the same work piece i.e., where L, D, K are constant values, the time, t, varies with the product A · v, which is the chip volume per minute (cubic in./min.) and which is dependent on the horsepower at the cutting edge of the lathe tool. The greater the available horsepower, the greater becomes the permissible chip volume A · v and the smaller the turning time, t. Cubic inches per grind are obtained by multiplication of A · v by the tool life.

The relationship between the cutting speed v, the chip cross sectional area, A, the horsepower at the tool P_t, and the material constant C_p follows from the fundamental law of mechanics, viz: power (P_t) equals the product of force (F) and velocity (V):

$$P_t = \frac{F \times V}{33000} \text{ H P}$$

Thus in our case:

$$V_M = \frac{33000\ P_t}{F} = \frac{33000\ P_t}{C_p \cdot (1000\ A)^r} \text{ ft./min.} \qquad (9)$$

This may be described as the second cutting speed law, or "machine-law."

By comparison of formula (9) with formula (1) (the first cutting speed law—or "tool law") **the very important fact will be seen, that two different relationships exist between chip cross sectional area A and cutting speed v. Basic principles which govern machining by single point tools can be derived from this fact as indicated graphically by means of the chart, Diagram 7.**

In this chart the coordinates are the chip cross sectional area A and the cutting speed v. Their relationship is represented now by two series of straight lines. The lines with the smaller slope are drawn according to the first cutting speed law formula (1); they may be called "tool lines" since they include the material of the tool due to the C_v values (Table I). The lines with the greater slope correspond to the second cutting speed law (formula 9); and may be called "machine lines" since their position on the diagram depends upon the horsepower of the machine.

The method of using this chart to explore the interrelated variables shown, and to determine their most effective comibnation is illustrated by the following example.

Assuming a machine of 8 h.p. net, a high speed steel tool 18-4-2 which shall stand 60 minutes, and a chip cross sectional area of A = 0.013 square inch, then it will be seen from the intersection point I, that the corresponding cutting speed would be 80 ft./min. This corresponds to the value obtained by calculation in the example given above. It is now desired to investigate the changes in the permissible cutting speed if the area of chip is changed.

1. Following the "tool line" in the direction of the arrow 1 results in an increase of the cutting speed v and a decrease of the chip cross sectional area A. In this manner, however, the "ma-

(Continued on page 46)

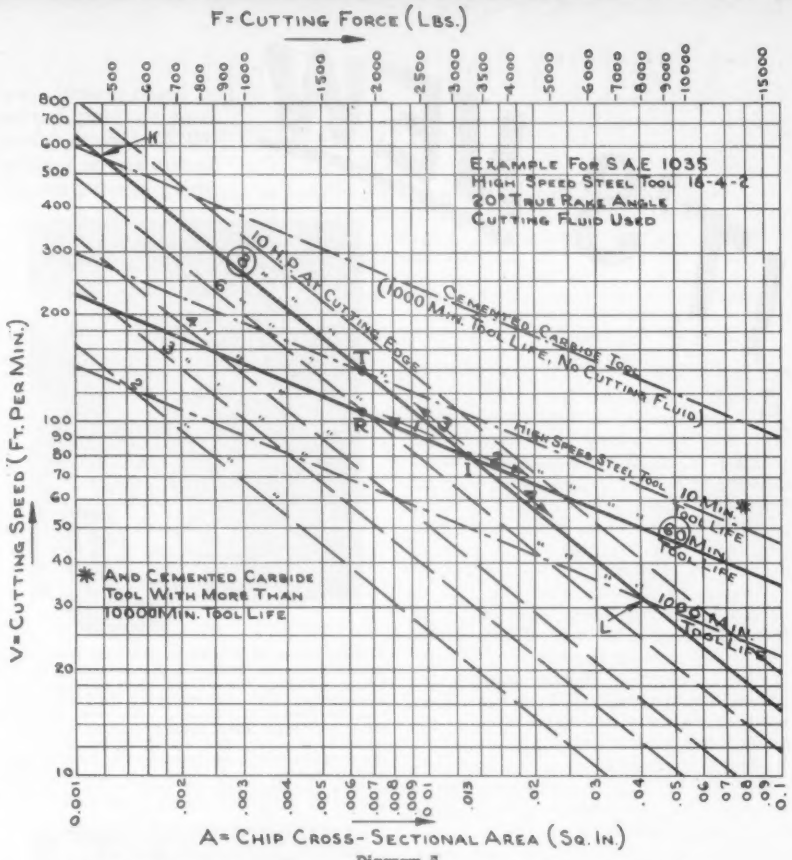

Diagram 7

Productivity diagram for selecting the most effective combination of cutting variables.

IT'S NEW

Keep posted—watch this page each issue. Planing and shaping hardened steels with hard carbides is NEW. Electroplating iron in thicknesses up to ½" as a process for making molds or dies is also NEW. Read this page for details.

A NEW process, known as Ekko (phonetic for echo, because of repetition) and which may revolutionize the making of molds and dies, has been developed by the United States Rubber Company. Originally worked out to produce cheaper tire molds, the process may now be applied to various embossing and forming dies, notably in plastic production. The principle is as old as electroplating; as a matter of fact, it is electroplating on a large scale. Only, the method applies iron instead of the non-ferrous metals usually deposited by this method. By this method, which apparently builds up stock in repeated laminations which merge into a unit, it is possible to build up thicknesses up to ½" at the present stage of development, as against .001 to .002 in ordinary plating.

While the process, like all new things, is in an embryonic but entirely practical stage, it needs no great vision to sense that it has unlimited possibilities, that further research may permit deposits of hard steels. A bulletin—"The EKKO process — electroplating with Iron"—has been prepared by U.S. Rubber Co., and may be had by those interested by applying to Sales Promotion Dept., mentioning THE TOOL ENGINEER, 1790 Broadway, New York, N.Y. This is something new that should not be overlooked.

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McKenna Metals Co., 600 Lloyd Ave., Latrobe, Pa., announces an interesting development of standard steel-cutting shaper tools tipped with Kennametal grade KS, for use on shapers and planers to machine steel of hardnesses up to 550 Brinell. This is believed to be the first time that hard carbides have been regularly used on tools for shaping hardened steels.

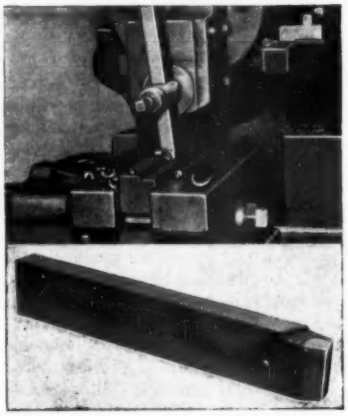
A feature of these new tools is the unusual tool angles employed, namely: 10° negative back rake, 5° negative side rake, 8° side cutting edge angle and 4° clearances. These tool angles, which should be maintained when regrinding are said to be made possible by the low frictional resistance between Kennametal and the work being cut. As a result, less frictional heat is developed than when high speed steel tools with conventional high side rake angles are used. With these tool angles it is unnecessary to lift the tool on the return stroke.

Kennametal shaper tools are said to shape steel of hardnesses above the machinable limit for high speed steel tools at speeds that are often double those used with high speed steel tools on work in the lower hardness ranges. Die blocks of 42 Rockwell C hardness, for instance, may be hardened before machining with Kennametal, saving the grinding operation that would be necessary if they were hardened after shaping.

Kennametal KS has a hardness of 76 Rockwell C but has a strength of 322,000 lbs. per sq. in. This combination of properties has made it practical to employ Kennametal-tipped tools for shaping and planning steel with results equal to those obtained when turning and boring steel with Kennametal. As in the latter case, they will take interrupted cuts without breakage and give longer service between re-grinds.

The sizes of tools furnished will fit standard clapper boxes of shapers and planers.

A new series of milling cutters has been announced by the McKenna Metals Company of Latrobe, Penna. These have been developed in co-operation with the McCrosky Tool Corporation of Meadville, Penna., and are said to have fast machining speeds with a high resistance to wear. The cutter shown is a 7" diam. shell end mill tipped with Kennametal and is milling S.A.E. Steel 4150 steel forging with a hardness ranging from 28 to 32 Rockwell C. The cutter is running at 92 R.P.M.



(Foreground) Typical shaper tool tipped with Kennametal grade KS. (Background) Machining steel with a Kennametal-tipped shaper tool at a speed in excess of 100 ft./min.

Band saw blades, in widths of ½" and under, are now packaged in a flat carton with one end of the coil always accessible. Both the new package as well as narrow band saws, down to 1/16", are new products of the W. O. Barnes Company, Detroit.

▼ ▼ ▼

McKenna Metals Co. also announces a new series of milling cutters equipped with Kennametal-tipped blades, which have been developed in cooperation with the McCrosky Tool Corp., Meadville, Pa.

The fast machining speeds and high resistance to wear found in Kennametal-tipped single point cutting tools are also characteristic of the new milling cutters. In the job illustrated, the 7" diam. standard McCrosky Jack-Lock Shell End Mill tipped with Kennametal grade KM is milling an S.A.E. 4150 steel forging that was heat-treated before machining to a hardness ranging from 28 to 32 Rockwell C. The cutter is run at 92 R.P.M., or approximately five times as fast as was possible with a cutter equipped with high speed steel blades. The feed is 3⅝" per min. and the depth of cut .125". An average of 160 faces were milled before regrinding was necessary, which was a much longer run than could be made with high speed steel blades.

The new series comprises nine standard sizes in each of the following types of cutters: Medium duty face mills, heavy duty face mills and shell end mills. Incorporated in these milling cutters are exclusive features developed by McCrosky engineers which are particularly advantageous when using

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PRE-DETERMINING PROFITS

TOOL COST ESTIMATING IS AN IMPORTANT FACTOR

The writer of this article puts it modestly when he says that cost estimating is an important factor in manufacturing. Rather, it is a vital factor in assuring profits. We are pleased to present so interesting an article to our readers, written by an authority in his field.—Editor.

COST estimating is a very important factor in manufacturing today. It is especially significant with manufacturers whose products are in a competitive field.

Estimating may be defined as the pre-determination of costs. In compiling the estimated cost, use should be made of actual cost figures, past or present, and of facts concerning the available plant and equipment, labor and burden rates, market prices of materials, knowledge of the various processes to be performed, and good sound judgment.

Cost estimates are necessary to make sales proposals, to bid on new work offered and to serve as a basis for special contracts. The work of estimating costs involves knowledge of engineering, production, costs and experience in addition to mature judgment. Good methods for estimating are essential. If an estimate is too low, money will be lost, if too high, work will not be undertaken or it will go to an under-bidding competitor.

Making an Estimate

Numerous factors must be considered in making an estimate. A few of the more important requirements are as follows:

(1) Previous estimate
(2) Previous actual cost records
(3) Anticipated future rates of labor, burden and material
(4) Use of machinery, building, tools and equipment
(5) Quantities to be manufactured
(6) Matured good judgment, etc.

Previous estimates, which were made on the same or similar parts, should be used in making or in checking current estimates. They are also useful in comparing and checking completed costs of the product as a whole, due consideration having been given to changes in labor rates, material costs, plant equipment and layout. This step saves a considerable amount of time and assures accuracy.

The cost records are the actual records of costs of products already made. They may contain the record of the article to be estimated or re-estimated, or the cost of a similar product. They may also contain the cost of various units or component parts which can be used in the estimate.

When using cost records for estimating, consideration must be given to factors such as excess spoilage, expense of repairs or re-operations, and inadequate layout of equipment which may have affected the previous costs and which should be eliminated in computing the current cost estimate. Care should be exercised in seeing that these records reflect the true costs based on quantities which are now expected to be sold. They may be available on first runs of product, for which no special production tools, jigs, dies or fixtures were made, but which were made with tools and equipment used on other jobs. Use of these tools, dies, jigs, fixtures and equipment intended for other purposes may have caused a greater labor cost than if the manufacturer had available special tools and equipment built especially for the job.

Labor—Burden—Material

It is a generally accepted practice to divide costs into three main divisions, namely: Labor, burden and material. Consideration should be given to the anticipated cost of labor, burden and material when compiling current estimates. This is important in labor markets that are subject to fluctuations and during periods when material prices are subject to frequent changes. The burden factor is subject to adjustments at all times due to changes in the organization of personnel, use of expense materials, and changes in use of machinery, tools and equipment. The cost estimating personnel should avail themselves of information as to the anticipated labor, and materials through trade publications and daily newspapers.

The cost of a product may be affected by the use of buildings, depending upon the layout and location of the building as regards the main plant, location of the main plant as regards the central warehouse, transportation facilities to and from one building as compared with another. The cost estimate may also be affected by the use of different machines; use of tools, jigs, dies, and equipment must also be considered in the same manner as use of machinery. It may be possible to build a tool to reduce the labor cost, but the cost of the tool or die may more than offset the labor which may be saved.

Quantities to be manufactured are also an important item. Die or machine set-up is a vital factor and must be considered when making an estimate. These set-ups are pro-rated over the amount to be produced and are a part of the direct labor costs.

By
B. M. HOOVER
COST ENGINEER
MIDLAND STEEL PRODUCTS CO.,
DETROIT, MICHIGAN

Briefly, having matured good judgment as far as the personnel of the cost estimating department is concerned—is being endowed with a good practical sense of values.

Elements of Cost

In making up an estimated cost of an article, various elements must be considered.

(1) Layouts and experimental work.
(2) Analysis of the various operations required.
(3) Tools, dies, jigs, etc.
(4) Labor.
(5) Burden.
(6) Material.

The first requisite, after receiving a request for quotation, is to check whether or not it is a part already being made or whether it is a new part. If a new part, material developments are made—(if a press product)—and if the piece is complicated, models are sometimes necessary. Great care should be exercised in making these developments in order to ascertain the correct amount of material required.

The next step is to analyze the various operations required to make the desired part. This work is performed by the process engineer and it is necessary that all operations are included. If some of the operations are omitted, money will be lost.

The cost of tools, dies, jigs, and fixtures is an important factor. The quantity of product to be manufactured usually determines the kind of tools, dies, etc., to be made. If a large quantity is to be fabricated, so-called permanent tools are recommended; if the quantity is small, cheaper tools or improvised set-ups may be used.

Tool estimates are made from previous actual costs of parts which are similar in nature. All tool record costs should be in the files of the estimating department for reference. Standards are made from these records and serve as a guide for future estimating. Careful consideration should be given to tool costs, because it is necessary that they be as accurate as possible. Often a contract is lost because of inaccurate tool costs. Cost of tools, dies, jigs, and fixtures are either quoted separately or are pro-rated according to the judgment of the various executives, usually the general manager or the sales manager or both.

The estimating of labor costs involves more computations than that of esti-

(Continued on page 38)

Production Perspectives

News of Mass Manufacturing from Everywhere

THERE are so many encouraging factors in the outlook for mass production industries for at least the first six months of this year that no comment is necessary—just judge for yourself from a few of the highlights presented in the following paragraphs—

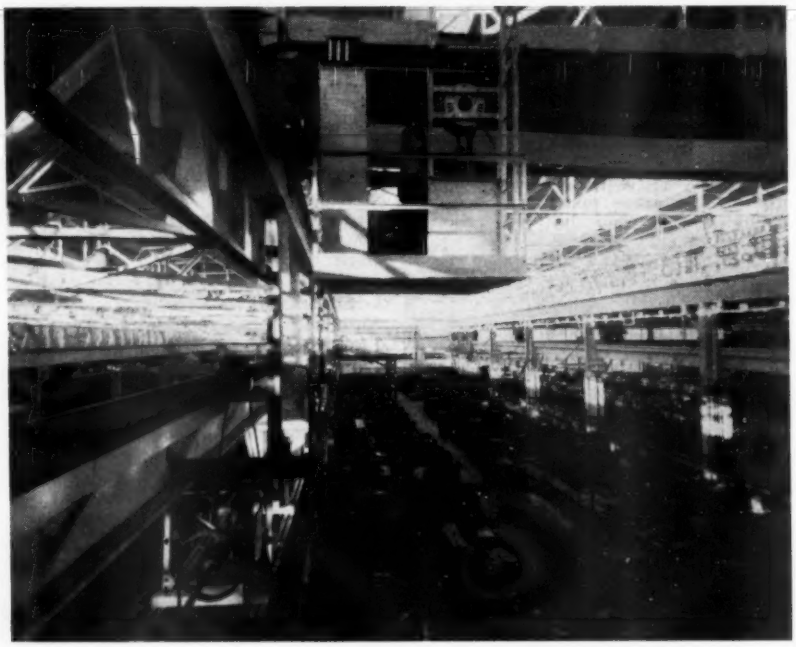
Production Highlights

The Federal Reserve Board, at Washington, D. C., said Jan. 17 that **American factories turned out more goods in December than in any December in American peacetime history.** The board rated **December's industrial production** on a seasonally adjusted basis at **128 per cent of the 1923-25 average.** This **was the highest index figure ever estimated by the board,** exceeding the 125 previous record figure of June, 1929, but it did not show up in the index so much because of seasonal factors. Also, officials said, present index figures should not be compared with 1929 unless allowance also was made for the growth of the nation's population, factory capacity and factory efficiency since then. Although production increased somewhat this month, the gain was not as much as is expected seasonally. **In December,** the board continued, **production actually declined somewhat from November's high levels,** but the index rose from 124 to 128 because **the decline was less than was expected seasonally between those two months. The 128 index,** however, **represented one of the fastest rises in American industrial history.**

The United States Circuit Court of Appeals, at Chicago, on **Jan. 9 set aside a decision of the National Labor Relations Board which ordered the Inland Steel Company to sign a written contract with the C.I.O. steel workers union. Judge J. Earl Major,** who wrote the unanimous decision, **commented: "This case illustrates the danger of placing in a single agency the multiple duties of prosecutor, judge and executioner." The N.L.R.B. order**—entered in 1938 and hailed at the time by labor leaders as a precedent-setting decision—**was reversed "in its entirety"** by the court and the **case was remanded to the N.L.R.B. for a new hearing. The C.I.O.'s demand** for a **written contract** was the paramount **issue in the 1937** "Little Steel" strike against Inland and three other independent steel makers. The Inland case reached the Court on an appeal by the company that in ordering it to reduce agreement with the Amalgamated Iron, Steel and Tin Workers of North America into writing, the board overstepped the limits of the Wagner labor relations act. **The company contended further that the N.L.R.B. trial examiner, Charles A. Wood, "was so biased and prejudiced as to deprive the Inland Steel Company of a fair hearing." The court agreed with the appellant that Inland was not given a fair hearing because of the examiner's attitude.** Counsel for the board, Ernest A. Gross and Richard C. Barrett, retorted that the conduct of the examiner was not important. They insisted that the examiner was correct in asking 11 of 700 company witnesses if they ever engaged in industrial espionage. **Judge Major's decision, concurred in by Judges Will M. Sparks and Evan A. Evans, upheld the company's contention that it was not necessary to reduce agreement between the company and the union's bargaining agents, the Steel Workers Organizing Committee, to writing.** The court held that Wood assumed the role of prosecutor and under cross-examination allowed the labor board attorneys unlimited right to examine steel company witnesses while restricting the questioning of board witnesses by the company's lawyers.

The United States Circuit Court of Appeals at San Francisco on Jan. 9 **held** that the **rights of employes to join a national or company union or decline to organize were "of equal value."** The ruling was made in denying an enforcement order for the National Labor Relations Board. **In the case of the NLRB against the Sterling Electric Motors, Inc., Los Angeles,** the **court held "even if the labor board has the power to deny such a civil liberty of employes and their union it was the abuse of its discretion to deny it in this case."** The board had asked for disestablishment of a company union and for a cease and desist order against the employer. The decision was two to one.

Pratt and Whitney, for seventy-nine years in downtown Hartford, set a precedent in manufacturing circles, when they moved production facilities two and one-half miles across town to a new streamlined plant. From 23 multi-storied buildings to one building, one story high—1000 feet long and 550 feet wide, with a separate two story office building, provides greatest working efficiency. Above is seen a view in the machine tool assembling department. (Photo—courtesy Pratt and Whitney)



The **new $6,000,000 Allison plant of the General Motors Corp. at Indianapolis** is **scheduled to begin quantity production of** its celebrated "mystery" **liquid-cooled warplane motor for the U. S. Army around the beginning of February. The high-precision 12-cylinder power plant,** which military experts believe will give United States fighting planes world air supremacy, **was designed by Allison engineers aided by Army aircraft technicians** after more than three years' experimentation. **The War Department has ordered more than $18,000,000 worth of the engines,** reported to total about 800 **at a cost of $24,000 each. Considered by military experts to be the greatest high-speed performance airplane engine in the world for its size and weight,** the **new power plant** was **designed especially to equip Army Air Corps pursuit interceptor and attack-bomber crafts.** Because of its liquid-cooling feature, the **Allison engine represents a radical departure in aircraft motor design in this country.** By employing this type of cooling, engineers were able to design

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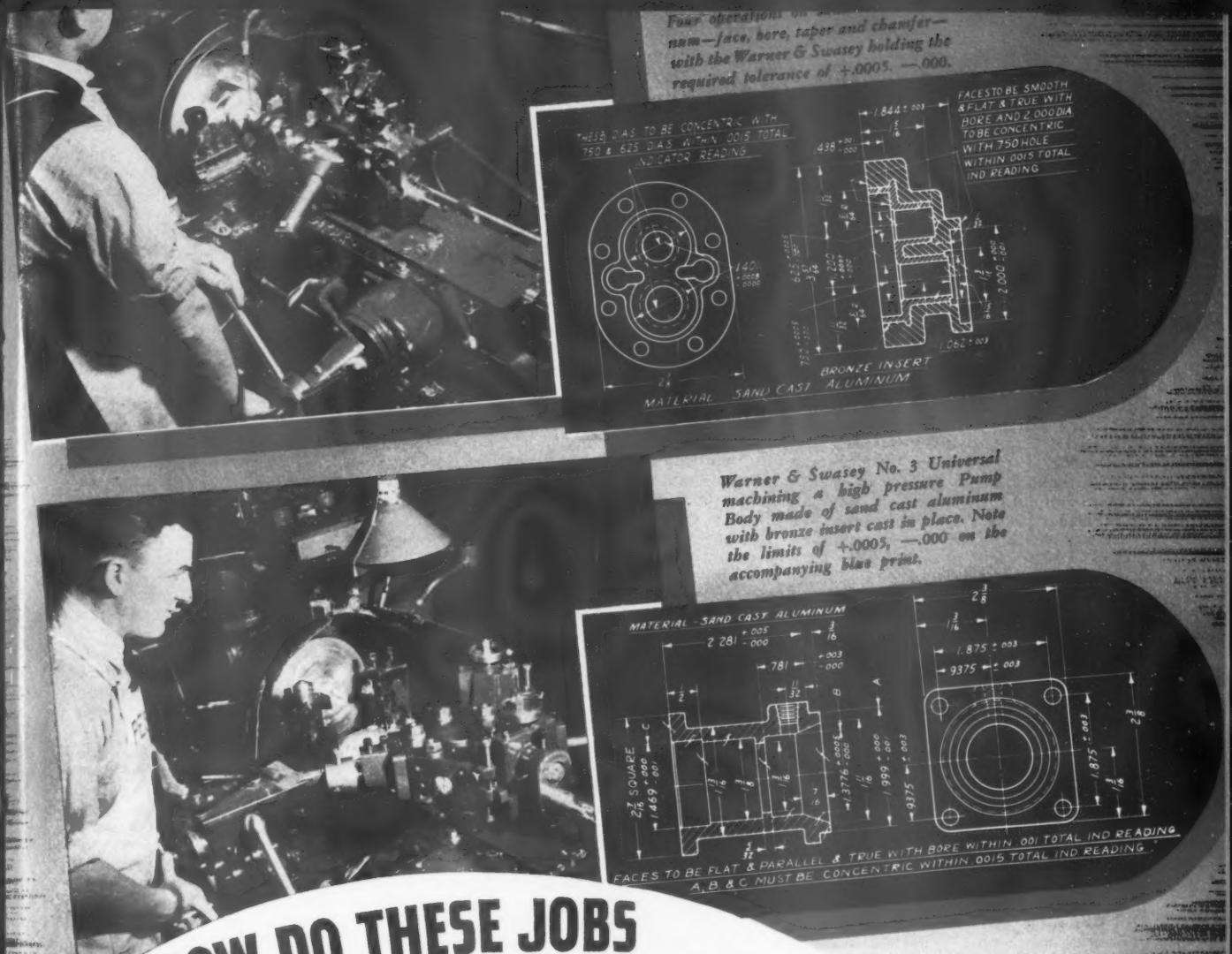

Four operations on this aluminum—face, bore, taper and chamfer—with the Warner & Swasey holding the required tolerance of +.0005, —.000.

Warner & Swasey No. 3 Universal machining a high pressure Pump Body made of sand cast aluminum with bronze insert cast in place. Note the limits of +.0005, —.000 on the accompanying blue print.

HOW DO THESE JOBS COMPARE WITH YOURS *for* ACCURACY?

• Pesco Pumps, so widely used in aircraft, are manufactured by Pump Engineering Service Corporation, Cleveland, Ohio.

The fuel flow, hydraulic landing gear, and automatic pilot all depend on Pesco pumps. Electric-driven Pesco Pumps also control the free feathering of the propeller and de-icing mechanisms.

These pumps are machined to close tolerances to assure their uninterrupted performance under all weather conditions.

In the shops of Pump Engineering Corporation you will find a whole battery of Warner & Swasey turret lathes at work. They are depended upon to accurately machine these close tolerances.

In your turret lathe department you, too, can obtain machining accuracy or high-speed production or power and rigidity on heavy-duty work if you use Warner & Swasey Turret Lathes. They are easy to operate, too—another advantage your men will like.

Whatever your machining problem may be, we believe we can be of help to you, so if you will write us we will gladly send our local Warner & Swasey field engineer to help you. There's no obligation—write

WARNER & SWASEY
Turret Lathes
Cleveland

YOU CAN TURN IT BETTER, FASTER, FOR LESS—WITH A WARNER & SWASEY

Chapter Doings . . . . By George J. Keller

THIS is the time of the year when most of us are thinking about skiing, skating, sleigh-rides and winter sports in general. The season usually starts just before Christmas. It is also the season for slippery, icy highways, which most of us fully know about. While we were all looking forward to the coming of Christmas and enjoying Christmas Day, tragedy stalked the highways around St. Louis. A happy family of four on their way to Spring Valley, Ohio, to spend the holidays with the "old folks back home," skidded on an icy highway and thus ended the career of Ralph Barnard Hartsock and his wife. "Harty," Mrs. "Harty" and their two children, Sylvia and Jerome, were enroute to Spring Valley for Christmas holidays when about 25 miles from St. Louis, their car skidded and crashed into a truck. Mrs. Hartsock was instantly killed and "Harty" passed away on Christmas Day. Little Sylvia received a bad cut over the eye and a broken nose and Jerome came through without an injury. "Harty" was born October 9th, 1905 in Spring Valley, Ohio and at the time of his death was a U. S. Army Ordnance Engineer under Major H. M. Readall and also Membership Chairman of St. Louis Chapter. He will be remembered and missed by his many friends in St. Louis and also by the Tool Engineers in Dayton, many of whom he had worked with in years past.

From the reports that I get from the various chapters, there's a great deal of chatting and planning about the annual meeting in New York. I am looking forward to it with a great deal of anticipation. Not just for the meeting alone but to renew old friendships, possibly dunk do-nuts in the wee hours of the morning with some of the boys, sing "Auld Lang Syne" or "Sweet Adeline." So much for that. I'm a day late and Roy Bramson is probably tearing around the office right now.

At the January 11th meeting of **St. Louis** Chapter, Ernest Nieman and Bob Laffler were elected to the nominating committee. Chairman Doogan, who has done such a spirited and effective job for the last two years, indicated definitely that he did not "choose to run" for a third term. The other officers and committee men have done their bit so there will probably be a new hot line up soon. C. A. Cox, local wheel representative of the Norton Company introduced and conducted a spirited discussion on the first talking picture supplied by the Norton Company on Abrasives, Grinding and Superfinishing. 175 members and guests attended the January meeting of **Schenectady** Chapter held in Rice Hall of the General Electric Co. Their speaker was F. W. Warner who talked on "Plastics." Motion pictures illustrated his talk. There were several out of town members at the meeting in spite of poor driving. Harry Crump, Ed Girardot and Ray Parkhurst were named to the nominating committee.

The January dinner and lecture of **Racine** Chapter was held in the main dining room of Hotel Racine. Mr. R. S. Drummond, President of National Broach and Machine Co., was the speaker. He spoke on their Roto shaving and gear finishing machines. One of the features of the meeting was the fine baritone of Joe Elwood's son, Joe, Jr. accompanied by his sister at the piano. A nominating committee was also appointed at this meeting.

Twin City's Chapter meeting was not an outstanding success from the standpoint of members present, owing to a raging blizzard and a small band of Indians that were seen lurking in the vicinity. Thirty of the fellows, excepting Bill Erskine, arrived on skis and snowshoes with their hair intact. After dinner a nominating committee was appointed. Mr. Edward F. Flyn, Director of Public Relations of the Great Northern Railway gave an inspiring talk on "Frontiers of Opportunity."

Rockford Chapter reached out over the surrounding territory of Freeport, Belvidere and Beloit, Wisconsin on January 4th to draw some 350 men to a real engineering meeting. The dinner guests were entertained by the songs of Joan Willoughby and piano playing of Violet Stakemiller. Col. Donald Armstrong, the speaker of the evening, described what the government expected of the Tool Engineer in the event of war. All arguments regarding the "built up edge" on a cutting tool were ended by Mr. Bruce when he showed slow motion pictures of a tool actually cutting. Here's to lots more slow motion pictures of other operations.

On January 9th **Syracuse** Chapter was addressed by J. L. Rogers of the Bakelite Corp. at a dinner meeting in the Industrial Club. Thirty-eight attended the dinner and one hundred thirteen members and guests attended the lecture on "Plastics in Industry" which was illustrated by slides, sound pictures and numerous Bakelite articles all of great interest to those attending. Leonard Smith and Wallace Ross were elected to the Nominating Committee. The Second Annual Dinner Dance of the Chapter will be held on Friday February 16th, at Drumline Golf and Country Club, the winter sport center of Central New York.

The first 1940 meeting of **Elmira** Chapter held in Hotel Langwell, Elmira, N.Y. on January 12th was a success. In spite of bad driving conditions, 84 were present for dinner with enough late comers to put the meeting attendance past the 100 mark. F. W. Warner of Pittsfield, Mass., General Electric Plant, was the speaker on Plastics of Today. A sound film, "Modern Plastics Preferred" was shown in connection with the talk. After the meeting and discussion a lively interest was taken in the large number of samples shown. R. E. Hopkins of Ingersoll Rand Company and E. P. Oldham of Remington Rand Inc. were selected as a nominating committee.

Wally Gray, factory manager Becton-Dickenson Co. and popular chairman of the meetings committee, was elected vice chairman of **New York-New Jersey** Chapter at its January 9th meeting to fill the post left vacant by Bill Brown's resignation. At the same meeting held at Newark, N.J., Frank Malhiot, chairman of the membership committee, and Jake Wohlfield, an active member of the speaker's class, were elected to the nominating committee. Earlier in the evening Frank reported the chapter membership at 287, still in second place, but with Hartford and Rockford trying to take the rail. Technical speaker of the evening J. K. Skelton, one of Brown & Sharpe's "experts" illustrated with numerous slides some unusual phases of screw machine tooling and cam design. One of the biggest crowds of the season came out to hear him.

Tri-City Chapter members and friends met at the LeClaire Hotel in Moline for the January 3rd meeting with about an even hundred in attendance. After dinner, Joe Rosen and Clyde Parker were chosen as a nominating committee. Stuart Lawson's talk on developments in "Modern Bronzes" was educational and well illustrated. "Look at the shake" was the gentle type of compliment for the members who had planned the jigs and fixtures shown in scenes of the Deere & Co. film on production methods. Then they handed us a comedy, "The Tuttle Tugger," an epic on what happens to bossy when a permanent wave machine gets mixed up with a milking "tool."

Toledo Chapter's January meeting was a dinner and technical session held at the Toledo Yacht Club and it sure was a knockout and great plans are under way to make the February meeting even bigger and better. In fact the chapter anticipates such a big gathering that it has made arrangements to have the next meeting in the main building of the new Y.M.C.A. Mr. C. W. Fick, District Engineer, General Electric Co. gave a grand rendition on the subject of "Recent Electrical Developments." The new year seems to have started off on the right foot. Everyone seemed to have new Zip. A.S.T.E'er J. P. Brown Asst. Master Mechanic of the Spicer Corp. treated twenty boys to the dinner and technical session. (Hats off to him). Just heard that Bob Haynes is enjoying himself vacationing in Miami, Florida.

(Continued on page 30)

Handy Andy Says →

SHOPPING for eats the Sat. before New Years, met Frank Gertiser and Swan Bergstrom, the latter having come all the way from Cinci. to buy his lutefisk. His Christmas order, it seems, had gone astray enroute. At that, neither of the boys seemed to be suffering from malnutrition, from which I surmise that business must be good in the milling machine line. Ford Lamb went and joined the Hounds, as I found out when Guardian-of-the-bone-pile Brigham—no no, Gardner!—Young (Pittsburg) relayed my membership card via our genial Exec. Secy. Welcome to the Pack, Ford! Connie Hersham's "Membarometer" is beginning to take on a professional air as our irrepressible Membership Ch'man gets into his stride. Between Roy Bramson's fine work in building up new Chapters and Connie's "Scotch Finding" hold on old members, we'll not only hold our own but grow and grow.

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A member, (an Englishman, by the way), who is going places with amateur photography—and whose wife, incidentally, is sport enough to take this in the spirit written—showed me some color pictures of which he is rightly proud. One of them portrays friend wife prone on the floor, reading a magazine, with the family pet beside her and taking a vicarious interest in the cover picture. "Nice picture," I suggested, "but why not take it over again, effecting a better profile of the girl friend?" "Listen, Andy," he came back, "when you can get an expression like that on a bulldog's face . . .!" After that, I'll put my bets on the English to win the war. They'll muddle through, somehow.

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One of the boys ribbed me mildly because, in writing about our advertisers, I feature a representative or an employe instead of the advertising concern. The charge is conceded, with reservations. It was not my original intention to feature advertisers, among whom are several past employers with whom my relations were mainly pleasant. Their ads stirred reminiscences connected with incidents or with cronies of bygone days who, like myself, started at the bottom of the ladder. My memory of Pratt & Whitney's is entirely pleasant, but the boys of '10 that I used to know have stepped up in the ranks, started shops of their own or taken their final promotion. One, I know, made himself a millionaire—but not as a Tool Engineer. Now, when I think of P & W, honest and likeable A. H. d'Arcambal (popular A.S.T.E. vice prex who should be stepped up) pops to mind, and I don't think his company suffers any because of my high regard for an individual. And, if I think of Gairing Tool Company, I'll likely as not personify it in Leader-of-the-Pack W. B. McClellan, although he is a comparatively recent acquisition to my circle of friends. My acquaintanceship with him dates from the time I first heard him leading the singing—and howl—at an A.S.T.E. meeting. Nor is Gairing Tool likely to feel slighted because I connect a good friend with a maker of good tools.

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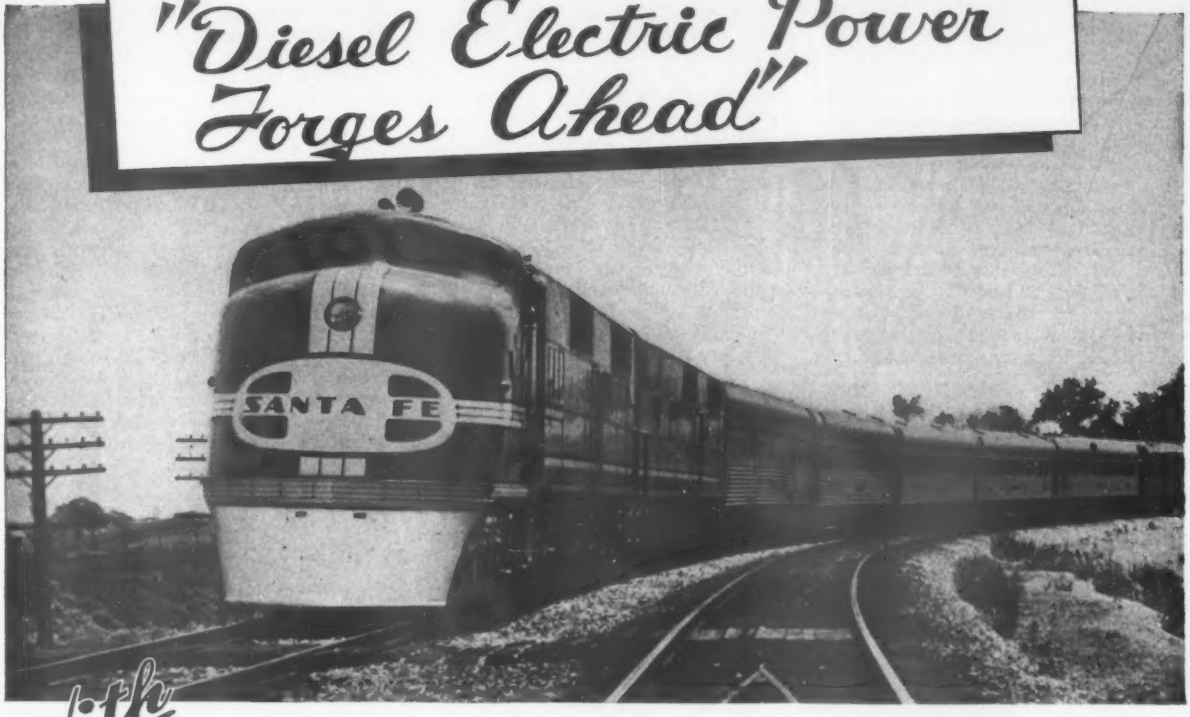
That holds true for other advertisers in which I have featured individuals rather than the firms. Knowing the men, and the concerns that employ them, I naturally think of quality. Years ago, in a New York newspaper, I read an editorial in which the soul of a corporation was personified in a humble employe who came in contact with the public. Analogous to that, the men I have mentioned are on the firing line for their respective employers, personify their respective corporations and incline me favorably toward the advertiser. They're that kind of men. The point is that we're all working for somebody (even when we think we're our own bosses we still work for the public) and that we make our bread and butter engineering what somebody has to sell if we are to keep our jobs.

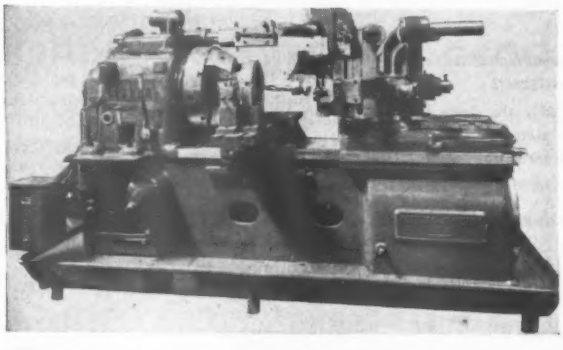
(Continued on page 28)

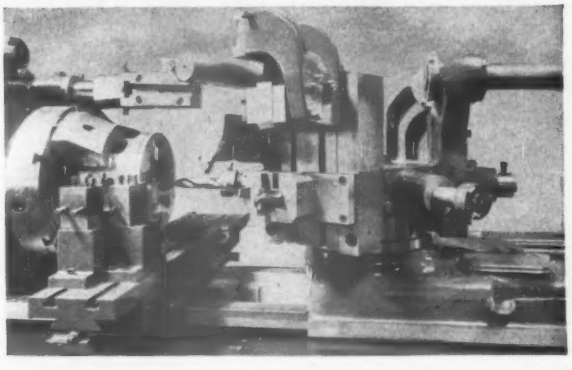
"Diesel Electric Power Forges Ahead"



With POTTER & JOHNSTON AUTOMATICS

PLUS: Special tooling developed through the cooperative effort of the customers and Potter & Johnston engineers have solved many difficult production problems, and Diesel engine cylinder head production offers an outstanding example.





The illustrations show the 5-DE Power-Flex Automatic setup for the machining of the first operation on the cylinder head. The second operation is performed on the same model. Potter & Johnston Engineers can doubtless assist in solving many of your difficult production problems. Send your drawings and we will supply complete information.

POTTER & JOHNSTON MACHINE COMPANY

PAWTUCKET, R. I. U.S.A.

FACTORY REPRESENTATIVES: William L. Martin, Headquarters at Factory: New England States and Eastern New York and New Jersey; A. W. Stone, 986 Kenyon Ave., Plainfield, N. J.; Western New York and New Jersey, Eastern Pennsylvania, Maryland and Delaware; G. Tell DuBois, 8-154 General Motors Building, Detroit, Michigan; Michigan and the City of Toledo, Ohio; Louis K. Voelk, 3865 Woodridge Rd., Cleveland, Ohio; Ohio—with the exception of Toledo, and Western Pennsylvania; Harry I. Schuster, 743 N. Fourth Street, Milwaukee, Wisconsin; Illinois, Missouri, Wisconsin, Iowa and Indiana. **AGENCIES:** Star Machinery Company, 1741 First Street, South Seattle, Washington; Henes-Morgan Machinery Co., 2026 Santa Fe Ave., Los Angeles, Calif.; Jenison Machinery Co., 20th and Tennessee Sts., San Francisco; Wessendorf Nelms & Co., Inc., 320 Franklin Ave., Houston, Tex.; Arthur Jackson Machine Tool Co., 60 Front St., West, Toronto 2, Ontario; Arthur Jackson Machine Tool Co., 437 Grosvenor Ave., Montreal, Canada; Burton Griffiths & Co., Ltd., Birmingham, England; R. S. Stokvis et Fils, Paris, France: Rotterdam, Holland and Brussels, Belgium; Maskinaktiebolaget Karlebo, Stockholm 1, Sweden; Ing. Ercole Vaghi, Milano, Italy; Yamatake & Co., Ltd., Tokyo, Japan; (Imperial Export Co., 44 Whitehall Street, New York, N.Y.); Almacca, Zurich, Switzerland.

HANDY ANDY SAYS—

(Continued from page 26)

And the open sesame for the salesman is the nationally advertised product.

▼ ▼ ▼

I might say, with reservations, that I am personally unacquainted with anyone at the Kearney & Trecker Corp., makers of Milwaukee milling machines. But awhile back, talking about New England, I was asked if I knew George E. Gustafson, former Fitchburger who heeded Greeley and trekked west, joined the West Allis (Wis.) concern and rose to the position of general works manager while still in his thirties. Now, I read, with a sense of loss, of his untimely passing in an automobile accident. In our world of engineering —and especially in this A.S.T.E.— we're most of us friends or friends of friends.

My vicarious connection with Kearney & Trecker, however, goes back to my days of single blessedness— say to 1912. A few days ago, there came to my attention a pamphlet in which the publisher showed his product installed on the new Rust cotton picker. Immediately the moving picture of memory began to whir, as I noted that the Rust machine embodied many of the essential features of the Price-Campbell cotton harvester, a pioneer in mechanical cotton harvesting. I took quite an active part in the development of that machine. Before I came on the scene, however, Kearney & Trecker engineers had worked out some very clever and soundly practical innovations. It is my unshaken belief that the P-C machine was mechanically right and years ahead of its time. The trouble was that promoters, who knew more of stock selling than they did of the fundamentals of engineering, forced on excess baggage that just bogged the machine down in the Texas blackland. Naturally, I am acquainted with the high quality of "Milwaukee" millers, (I should be, having used them enough) but the incident of the P.C. cotton picker at once establishes a bond and proves the versatility of K. and T. engineers. You see how it is. I don't have to grope for names, rather, my mentions are usually based on some personal and interesting experience.

▼ ▼ ▼

Take Universal Engineering Co., for instance, a consistent advertiser in "The Tool Engineer" whose product is as essential to Tool Engineers as the famed Frankenmuth (Mich.) chicken dinners are to the Company's home town. I am not personally acquainted with the company's personnel, but I do know that Universal's Mr. W. R. Fisher is a big game hunter of note. He has a series of moving pictures—as "Moose Hunting in British Columbia," "Home on the Range" and "Caribou Cavalcade"—which he might be prevailed upon to show at some of our A.S.T.E. meetings. And they're good!

Coming closer to home, Al Nancarrow, (of Duplex Equipment Co.) local Universal representative, is a friend of many years standing. Al is a widely experienced Tool Engineer, and was one of the first men under whom I worked when I came to Detroit in '22. I have held him in friendly regard ever since, and naturally, that creates a friendly bond with Universal Engineering Co.

▼ ▼ ▼

I don't recall ever having peddled books, although I have turned my hand to many things in the course of time. But I would like to recommend a serial now running in the Saturday Evening Post—"The Valley of the Sun" (Kelland)—which is not only interesting reading but an epic in the settling of the west. The dialogue is infectious, subtle humor and Yankee trading shrewdness contrasting with the stark tragedy of the desert. Through it all runs that granite quality which makes the Vermonter and some of our immigrant stocks the very personification of rugged perseverance.

The trail to the west was blazed with axe and musket, the wilderness conquered with sinew and bone. And the men who dug ditches and guided the plows, together with their indomitable women, laid the foundations of the America of today. In the wake of the pioneers came the cities, with their latter day glamor and sophistication. I

(Continued on page 40)

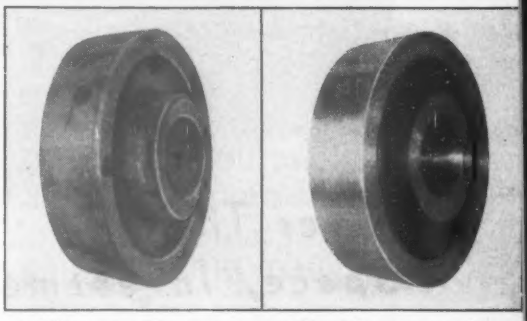
IN PEAK PERIODS

You can depend on the New Gisholts for greater production

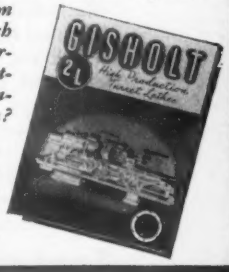
● This manufacturer, for example, installed a new Gisholt 2L High Production Turret Lathe, which machines these large turntable rollers 65% faster—saves 700 hours on a year's production! Those 700 man and machine hours saved are now turned over to other important work.

It's wise to keep your machine shop equipment up to date—to take advantage of the saving in time and money which the new Gisholts make possible. A Gisholt engineer can show you where and how you can do it.

"YOUR SMARTEST INVESTMENT TODAY—BETTER MACHINE TOOLS"



★ *These 10" rollers are now machined in two operations—from rough to finished, in 39 minutes (it used to take 60). Largely responsible for the reduction in machining time is the Gisholt Cross-Feeding Hexagon Turret; the rapid traverses which enable the operator to bring the carriages quickly into position for cutting. Of course, there are other reasons, too. Why not learn about them?*



This new bulletin describes the Gisholt 2L High Production Turret Lathe, which performed this work. Your copy will be sent upon request.

GISHOLT

GISHOLT MACHINE COMPANY

1229 EAST WASHINGTON AVENUE, MADISON, WISCONSIN, U.S.A.

TURRET LATHES · AUTOMATIC LATHES · TOOL GRINDERS · BALANCING MACHINES

CHAPTER DOINGS

(Continued from page 24)

Hope he has a good time and Toledo is still looking forward to seeing him at the coming dinner meeting.

The ghost of Paul Bellamy stalked through the regular meeting place of the **Cleveland** Chapter during the January Meeting as Ben Williams addressed the meeting on the aims and ambitions of Technocracy. The discussion period was plenty lively as Hank Sauer, Rudy Fintz and Mike Lloyd and many others mildly protested in favor of present political opinions. It was all Briner could do to get the discussion terminated and finally he had to wield the "big stick." The members unanimously elected Rudy Harrold and Rudy Fintz as the Nominating Committee. It was a pleasure to greet a new comer, John Bradner, Jr. of Lees Bradner Co. and it is to be hoped he comes often. Lou Langer of National Screw and Ray Abernethy of Cuyahoga Steel and Wire were spotted over in a corner discussing wire drawing until Dorm Miller of Steel and Tubes came along and broke up the session.

Detroit Chapter held its January 11th meeting in the Webster Hall Hotel ball room. Ford R. Lamb, Executive Secretary recalled, to the interest of many, that the meeting room was the same one used by a group of Detroit Tool Engineers, nearly 8 years ago, who had met to form an association of Tool Engineers, now the ASTE with 31 chapters scattered in all corners of the country, with two branches on the Pacific Coast, a chapter on the Gulf Coast, another in Canada and others in almost every important industrial center throughout the nation. W. D. Grindley of the Watson Stillman Company spoke on, "Under the Ground and Under the Sea with Hydraulics," giving some of the hydraulic applications not ordinarily used or thought of by Tool Engineers. His discussion was highly interesting as well as instructive. Telling first, of the use of hydraulic jacks and the "shield" which is used in constructing underground tunnels he struck a theme that brought forth a flood of questions and answers. Later a discussion of the difficulties involved in the construction of the Bath-O-Sphere, used by Dr. Beebe in his underwater research, raised many interesting points of discussion. A working model of the tunnel shield and many interesting pictures of the Bath-O-Sphere were also on display.

Ontario Chapter had a very enthusiastic meeting on Friday January 12th in Hamilton when one of its own members spoke on Jigs, Tools and Fixtures for Aircraft Production. J. D. N. Gray, who recently had charge of the tools and fixtures for the Handley Page Hampden Bomber, was the speaker for this interesting and timely aircraft session. The next meeting on February 9th will be held in Toronto and G. H. Sandborn of Fellows Gear Shaper Co. will talk on "Recent Developments in Involute Gearing."

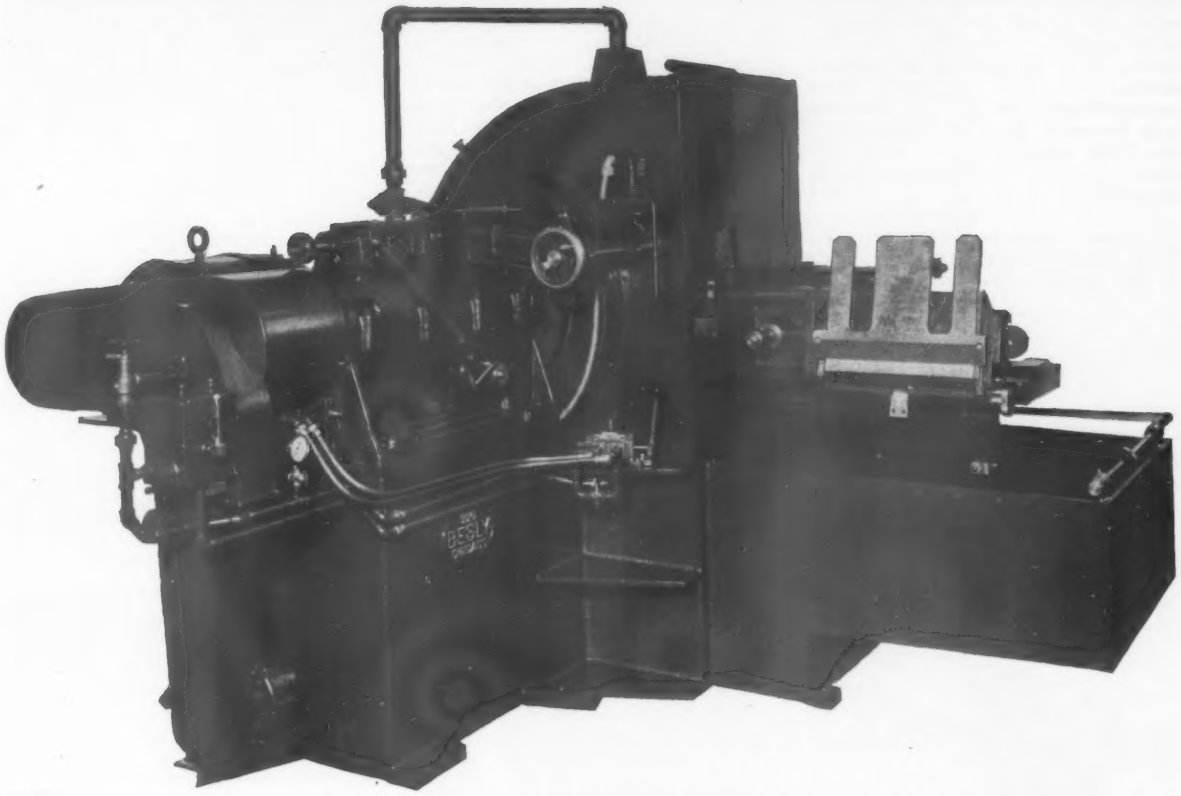
Hartford Chapter held a dinner meeting at the City Club with about 90 members present, on Monday, January 8th. There were a number of visitors present from Worcester, Greenfield and Bridgeport. The coffee talk was given by W. J. Lee, Sports Editor of the Hartford Courant, who spoke on sidelights in the sport field centering his talk on the organization of the New York Yankees Baseball Club. The technical session was held at the Gas Co.'s auditorium. Bill Gurley and Harry Hauck were named to the nominating committee. W. T. Robbins, of Carboloy Tool Co. gave an interesting talk on Tungsten Carbides. His talk was illustrated by charts and slides.

Buffalo Chapter held a dinner meeting at the University Club on January 11th with about 50 members present. A nominating committee was appointed consisting of Scott Osgood, Wm. Weinreich and myself. The speaker of the evening was Frank Warner of the General Electric Company of Pittsfield, Mass. who spoke on "Modern Plastics." After the meeting a film on Tuna Fishing was enjoyed by everyone.

Cincinnati Chapter had a bang up stag party January 12th, with about 120 members and guests attending. Bowling took up the first part of the evening after which a short business meeting

(Continued on page 40)

Versatile IS THE WORD . . .



HERE is one of the many Besly Grinders designed by our engineering staff for a specific purpose. • Several of these Special Besly Grinders are at work daily in the plants of one of the well known tobacco manufacturers sharpening knives illustrated at the rate of 60 per hour. A Quick Clamping Indexing Type Fixture enables operator to chuck one knife while another is being ground. Feed of wheel and travel of table are hydraulically controlled.

Write for your copy of Booklet on Besly Titan Steelbacs.

The Besly Titan Steelbac Abrasive Wheel (Ring Type) with perforations plus plenty of coolant insures a fast grind with no danger of burning. • If you are interested in flat surfacing, investigate the possibilities of Besly Grinding. On work within its sphere it usually means faster grinding, lower abrasive costs and often a better class of work. Put your flat surface grinding problems up to the specialist in the field.

CHARLES H. BESLY AND COMPANY

118-124 NORTH CLINTON STREET ✱ CHICAGO, ILLINOIS

PRODUCTION PERSPECTIVES

(Continued from page 22)

a motor more adaptable to streamlining than the familiar air-cooled radial type which up to now has been standard on a majority of the Army's combat planes. Also **because of its unusual length,** more than 90 inches, **plane fuselages had to be specially designed to fit the motor. Rated at between 1150 and 1200 horsepower at takeoff,** the **motor** is reported to be **capable of amazing speeds** in certain types of crafts in which it has been fitted experimentally up to now. It **was reported unofficially** that **a pursuit-interceptor fitted with two of the Allison 12-cylinder creations tested recently** in a cross-country dash **at better than 450 miles per hour.** This sustained speed is considerably better than any reported performance of fighting planes of any other major country in the world. While the new factory readies its costly custom-made machinery to begin producing the 12-cylinder Allison engine, **a 24-cylinder version,** considered the **"world's most powerful aircraft engine"** is being **held for possible later quantity production. This version** of the Allison models was **designed for larger bombers of the "flying fortress" type.** As closely guarded as the design of the motor itself, is the new streamlined "controlled conditions" factory located within a stone's throw of the famous Indianapolis Motor Speedway. Uniformed military guards patrol the plant and its grounds 24 hours a day, on the alert for any evidence of spying and ready to thwart any attempt at sabotage. More than **2500 persons will be employed in Allison's new unit by the time quantity production reaches a full swing.** Each one of these employes, getting their jobs, was required to submit his birth certificate and to undergo thorough investigation. During the six months that the new factory has been under construction, the experimental plant built two years ago has been turning out finished motors. Because of the limited large-scale production facilities at the older plant, only two 12-cylinder motors have been turned out each week. The new plant was designed to produce 12 engines per day on a 24-hour work basis. It is expected that the plant will begin at capacity operation.

Factory employment in New York State in December remained unchanged from November, maintaining the gains made during the past four months, **according to a report issued by Industrial Commissioner Frieda S. Miller at Albany, New York.** Payroll totals continued on the upgrade with a gain of 1.7 per cent over November.

Associated Industries of Massachusetts predicts for 1940, an **increase of 5 to 10 per cent** in the **state's manufacturing business.** The **forecast was based on reports from 200 industrial concerns** and surveys of the state, showing a substantial increase in the number of new industries, plant expansions and new products. **"A large number of plants are working overtime with unfilled orders,"** says the prediction, **"Employment is increasing,** executive confidence is growing, industrialists are planning further ahead and considerable **enterprise is being shown in improving products** and in the purchase of machinery and tools."

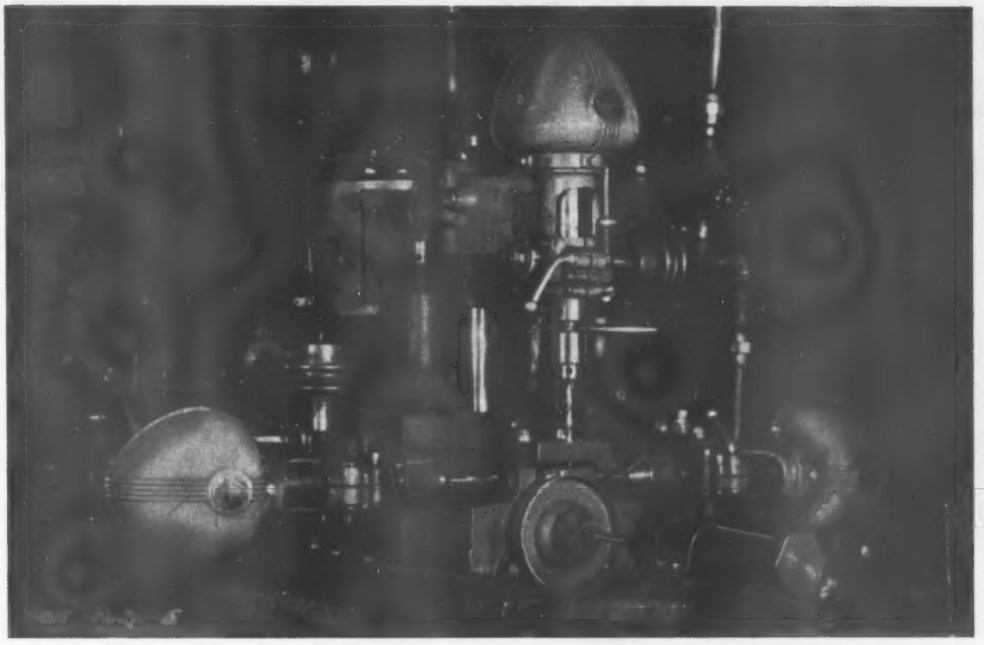
Sales of Willys-Overland Motors Inc. cars since the start of production on 1940 models on **Oct. 1** have **exceeded the total for the entire year of 1938, according to M. J. Golden, general sales manager.**

Gear sales for December showed a gain of 37 per cent over the corresponding month of the preceding year, but were 12 per cent below November, according to the American Gear Manufacturers' Association. **Sales for the year were 36 per cent larger than in 1938.**

Middle West

Manufacturing firms in Greater Cleveland received government contracts totaling $725,287 in December. Sharing in the awards was the National Acme Co., which received a $98,235 order from the United States Air Corps for airplane wheel and brake assemblies. **The United States Navy awarded the Cleveland Pneumatic Tool Co. an $83,232 contract for landing gear struts. Another navy contract, for $36,833, went to the Electric Products Co.** for motor generator sets and motor control equipment. Maxwell R. Berry, president-treasurer of the com-

(Continued on page 36)



Special set-up using 3 Delta Drill Press heads. With this set-up the operator drills 3 holes at once and taps 2 on another Delta Drill Press during a milling cut so that these 5 operations are obtained at no extra labor cost.

NEW METHOD for making Special Set-ups

Alert production men all over the country are utilizing this new method for building special set-ups at a fraction of former costs. Delta 14" and 17" Drill Press heads can be purchased separately—and assembled in any combination that best fits your needs. They can be used in any position—vertical, horizontal or at any angle—because their self-sealed ball bearing construction eliminates lubrication problems. Their low cost makes them more economical than anything that can be made up in tool rooms or machine shops. It will pay you to investigate.

A Complete Line of Low-Cost Drill Presses

Delta sensitive drill presses that cost less than $50 are doing work today that $150 drills would not handle a few years ago! They're not merely new tools—but a NEW TYPE of tools. Thousands of these new Delta Drill Presses are saving hundreds of thousands of dollars for alert manufacturers all over the world.

Here are a few reasons why: Their first cost is less—from 50% to 75% lower than old type machines. Their maintenance cost is less—they require less power, less attention because of their sealed-for-life ball bearings and V-belt drives. They are flexible and in most cases portable. They can be moved around to fill in "waiting time" and meet changes in the production line. They can be adapted economically for special set-ups for special jobs.

SEND FOR NEW CATALOG

Mail coupon for latest Delta Catalog of Industrial Power Tools. It contains specifications and prices of complete line of Delta Drill Presses plus details on individual parts from which you can make your own low-cost assemblies.

$43.55

No. 1289—Floor type Slow Speed 14" Drill Press with ½" Chuck and Standard Tilting Table (without motor).

DELTA MFG. CO. (INDUSTRIAL DIVISION)

623 EAST VIENNA AVENUE
MILWAUKEE, WISCONSIN

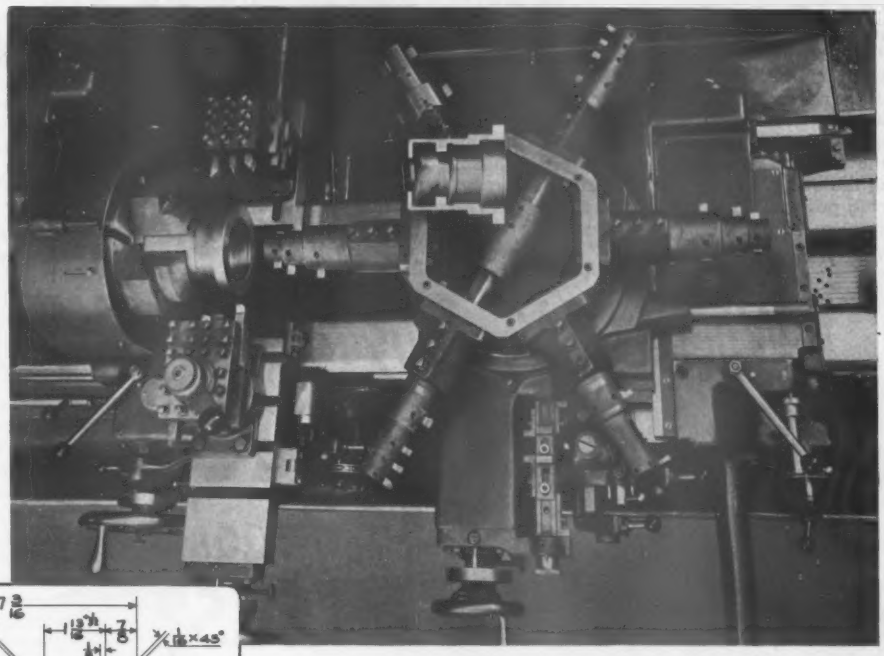
Delta Mfg. Co. (Industrial Division)
623 E. Vienna Ave., Milwaukee, Wis.

Gentlemen: Please send me your latest Catalog which contains specifications and prices of your complete line of Drill Presses.

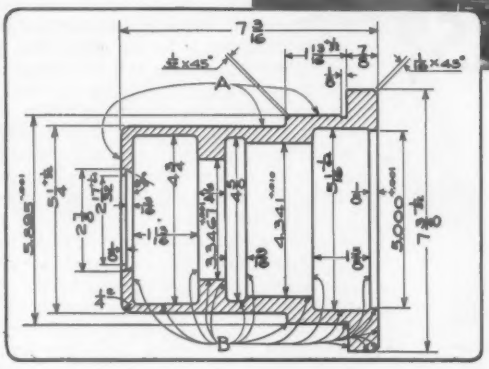
Name .....
Address .....
City ..... State .....

Profits from Modern Machines

Jones & Lamson Universal Turret Lathes enable you to make the most of new hard alloy tools



Substantial Savings resulted when it proved possible to finish machine the interior and flange of this cast iron clutch housing *in one operation* on a Jones & Lamson 7-B Saddle type Universal Turret Lathe with *Cross Sliding Turret* and *Bridge Type* Carriage.



The surfaces marked "B" indicate those machined in this operation (see also section of work on the turret in the illustration). All external surfaces were machined while internal boring and facing cuts were being made. Hard alloy tipped tools were used and floor to floor time averaged less than 6 minutes per piece.

The *full universal features* of the Jones & Lamson 7-B make it a particularly *profitable investment* where much internal work is required. Its versatility reduces operations and cutting time to a minimum, with a consequent increase in production and *Profits.*

NEW SADDLE AND RAM TYPE UNIVERSAL TURRET LATHE CATALOGS, describing the construction and operation of these machines, will be sent to you upon request.

JONES & LAMSON MACHINE COMPANY

SPRINGFIELD, VERMONT, U. S. A.

MANUFACTURERS OF: SADDLE & RAM TYPE UNIVERSAL TURRET LATHES . . . FAY AUTOMATIC LATHES . . . AUTOMATIC DOUBLE-END MILLING & CENTERING MACHINES . . . AUTOMATIC THREAD GRINDING MACHINES . . COMPARATORS . . TANGENT AND RADIAL, STATIONARY AND REVOLVING DIES AND CHASERS

PRODUCTION PERSPECTIVES

(Continued from page 32)

pany, said the generator sets would be used for charging and servicing batteries in submarines. **The Panama Canal Authority placed an $89,658 order with the Republic Steel Corp.**

Edwin C. Barringer, at the twelfth annual convention of the Institute of Scrap Iron and Steel, at Pittsburgh, **said** January 10 that **the automobile industry consumes more steel in one week than does the United States navy program in three years.** Barringer, Executive-Secretary of the Institute, said **half of all steel manufactured comes from scrap** and that **scrap dealers last year sold 34,800,000 tons to the steel industry.** Only **dealers along the coast export to Japan and the warring powers,** and their sales are but a "drop in the bucket" compared to local consumption, Barringer said.

Fred J. Prindle, a machine designer for the **Warner & Swasey Co., Cleveland,** on January 9 **was awarded a gold watch chain by Charles J. Stilwell, president of the firm,** marking the completion of 50 years of service. The presentation was made at a luncheon in honor of Mr. Prindle at the University Club. Mr. Prindle, who is 72, commutes daily from his home in Perry, O. **Only one employee of Warner & Swasey, George A. Decker, works engineer, has a longer service record than Mr. Prindle. Mr. Decker was awarded his watch chain eight years ago.**

East

Among leaders in Springfield, Massachusetts' drive to regain industrial prosperity, is the Springfield Armory where employment today is the greatest since the World War. **At the beginning of this year,** the federal institution **had 2,370 employes,** an increase of 1,470 since January, 1937, and nearly 800 during 1939. **Col. G. H. Stewart,** commanding officer, **reported that the armory was busy manufacturing numerous items in connection with the army's small arms needs.** Production of the Garand rapid fire rifle may be credited with the expanding activity, and will be a reasonable guarantee of continued operation at the present rate.

From the **Monsanto Chemical Company's plastics division** in Indian Orchard, **comes word that** during the past four months the **major part of the plant has been running at full capacity** in order to keep pace with the increased demand for almost all types of plastics. With the last-quarter increase, it was stated, 1939, will undoubtedly show a definite improvement over 1938. **Current employment was reported at about 1,250, a gain over last year's figures.**

Works Manager William O. Lippman, of Westinghouse, East Springfield, says the 1939 volume of sales at the plant **showed a marked improvement over 1938.** "It is expected that the first part of 1940, as far as we can look ahead, will continue at about the same rate as during 1939," Lippman said.

Willis C. Robbins, 69, president of the Robbins-Ogden Machinery Corporation of Boston, until his retirement two years ago, died recently **at Wakefield after a long illness.**

Production of machinery and tools in Rhode Island plants has continued apace during recent weeks and current opinion in the industry is to the effect that the high level of activity will continue. Operations in many plants have approached capacity levels on a single shift basis to all practical purposes and other companies have continued to add extra hours and extra shifts where the supply of skilled labor makes such a move possible and economically feasible. In the midst of the existing heavy demand for all types of machinery and tools for both domestic and foreign customers the question arises as to whether or not current buying represents a reduction in the huge potential demand for equipment which manufacturers have said was built up during the slack depression years from 1930 through 1936.

West Coast

Southern California aircraft manufacturers appeared certain Jan. 15 **to receive substantial orders for additional fighting planes for** the **British air force,** it was reported from Washington. **Negotiations** with a view to placing contracts, primarily **for bombers,** are said to be **proceeding satisfactorily,** and there are indications that definite agreements will be reached within the next few weeks. **Large orders** are **in prospect for Douglas Aircraft Co.** of **Santa Monica and Lockheed Aircraft Corp. of Burbank,** while a smaller order is likely to go to **Consolidated Aircraft Corp. of San Diego.** There is some chance also that the **British will order more ships from North American Aviation, Inc.,** of Inglewood.

with the O. K. TOOL CO.

A stamp of approval is always gratifying. Somehow or another this is especially true when it comes from a manufacturer of small tools.

That is why we are featuring the illustrations on this page which show a Landis 14" x 48" Type C Hydraulic Universal Grinder at the plant of the O. K. Tool Co., Shelton, Conn. These people use the machine for a wide variety of operations in the manufacture of milling cutters and reamers. Operations of this kind always require the best in equipment and craftsmen.

The satisfaction which has been expressed by this user is typical of the comments we have received from many others who employ Landis Type C Hydraulic Universals for a wide variety of grinding operations. When you are in the market for grinding equipment for tool room or light manufacturing use, you too will probably say O. K. when you realize what the Type C can do for you.

273

LANDIS TOOL CO.

WAYNESBORO PENNSYLVANIA

J47 — Grinding the standardized drive arbor of a face milling cutter.

J48 — Circle grinding the periphery of a heavy duty slab milling cutter.

J49 — Circle grinding the adjustable inserted blades of a line reamer.

(Continued from page 21)

mating the cost of material and burden. The cost estimator must have a knowledge of the various operations which will be performed, tools that will be used, machines that will be employed and departments in which the product will be manufactured. He must also be familiar with labor rates, in order to estimate the labor cost with any degree of accuracy. The labor operations should be written down in detail on specially prepared sheets and all operations should be listed in sequence. If the article to be manufactured is composed of various sub-assemblies, each one of the sub-assemblies should be broken down into component parts and the labor operations on these parts should be listed in detail.

In estimating set-up time, the cost estimator should have available in his files standard set-up costs on all operations, which should be compiled by the time study department.

In estimating the cost of material, care is required as to the use of present market prices or probable future prices if the job is to be made in the future. Due allowance should be made for waste and spoilage in fabricating the materials.

The application of burden on cost estimates should be the same as used in a manufacturer's cost system. This will enable the estimating department and the cost department to compare estimates with actual costs and thereby to set up relative standard costs.

The cost estimating division should be under the direct supervision of the general manager so that it would not be subject to the direct influence of sales manager, financial manager or production manager and so tend to favor any one of these departments in fixing the prices of the product.

The Cost Estimator

The experience of the personnel of the cost estimating department should include both general and cost accounting experience, engineering training, the ability to read blue prints, production experience and a thorough knowledge of shop layout and equipment, experience in time study and methods engineering, tool cost and design. A keen sense for analysis, processing and also the ability to keep abreast of the ever changing conditions are also essential qualifications.

The cost estimator must have engineering ability because he is constantly confronted with problems of estimating on products which have not been previously manufactured. This ability should enable him to determine whether or not further engineering work is necessary before proceeding with the cost estimate.

One of the necessary qualities of a cost estimator is a thorough knowledge of plant layout, production methods, and machinery and tools available. If a new product comes in for estimating, he should know in all ordinary cases where the product will be made, what processes will be required for its complete fabrication, what price labor will be used, kinds of material which will be worked upon, and what type machines and tools are available for its production. He should have a knowledge of tools and equipment on hand so as to guard against estimating on new tools where old ones may be utilized. He should also know the production capacity of the plant so that he can determine whether or not the time allowed for production is sufficient.

In the organization of the cost estimating division requiring several employees, it is feasible to employ men who are specialists in various lines of production or specialists in the functions previously mentioned, such as a man familiar with cost accounting, time study and methods engineers, material development man, process engineers familiar with tool costs and design, etc. The cost estimator should at all times keep in close touch with all sales activities and the sales department should keep him informed as to all current changes on conditions in the field and immediately transmit all information pertaining to new business. It is necessary that the cost estimator should have available the cost department records of previous costs of articles to be produced, or similar

(Continued on page 40)

When The Armistice Is Signed

. . . and the flame and crash of battle are replaced by the tolling of bells, the shrieking of whistles, the roar of happy crowds . . . the question "What of tomorrow?" will again occupy men's minds. Once more, men will plan to adopt machines engineered-for - greater - human benefits, whose use improves social and economic conditions by raising the standard of living. The Monarch Machine Tool Company, Sidney, Ohio, U. S. A.

Monarch Lathes

CHAPTER DOINGS

(Continued from page 30)

was held to elect a nominating committee. Those elected were J. B. Elfring and Fred Schoeffler. The real fun then started. Magicians, dancers accordian players, card games and plenty of Dutch Lunch and Beer. Prizes were awarded for the best bowlers.

Ninety-six members attended the January 8th meeting of **Worcester** Chapter at Putnam & Thurston's Restaurant. Stan Bath and Al Belden were named to the nominating committee. Four attendance prizes were distributed to the members. Chairman of meetings, Arthur Starrett, sang a solo and when Arthur imitated Bing Crosby it really was something. Chet Bath and George Bickford outweighed him two to one for a duet, (so Bick sang Wonder Why). Joe McGowan visiting fireman from Pawtucket also sang. As usual "Sweet Adeline" was the No. 1 hit followed by "Roll out the Barrel." The meeting was just a get-together and now that they are all acquainted they expect to have some real meetings. It's the first Monday in the month if any of you boys get down Worcester way.

Rochester Chapter held its meeting on January 10th at the University of Rochester, Strong Auditorium. About 85 members and friends attended. F. W. Warner of Pittsfield General Electric Company spoke on "The World of Tomorrow." William Gordon, Emmett Moore and Fred Bittner were named to the Auditing Committee and the chairman appointed James Breslin, Charles Seely and Victor Anderson to the nominating committee.

The feature of the January meeting of **Dayton** Chapter was the acquisition of nine new members, eight of whom were due to the effort of Emerson Carmony. Herman Poock and Reber Stupp were named to the nominating committee. The speaker of the evening was Millard Romaine, of the Cincinnati Milling Machine Co. who spoke on "Horizontal Broaching." The lecture was illustrated with slides and motion pictures.

South Bend Chapter held its meeting on January 11th. Mr. Wentzell Chairman of the Membership Committee announced the new members and gave a brief talk on how to secure new members. Herbert Chase, the speaker of the technical session spoke on "Jigs and Fixtures For Machining Die Castings." He showed numerous slides of samples taken in various plants. Hales Parrish, George Garvin, Clarence Paden and Charles Roskuski were named to the nominating committee. The meeting was well attended there being about 110 members and guests present.

PRE-DETERMINING PROFITS

(Continued from page 38)

articles. He should also keep in close touch with the general trends of the costs of labor, burden and material as reflected in the information available in the cost department.

The thoughts set forth in this discussion are general in scope and may be used to some extent as a criterion for those considering the installation of a cost estimating department, rather than for those who have evolved satisfactory methods now in force. Rather an endeavor has been made here to convey the importance of cost estimating and the necessary general conditions, as well as the various functions involved and the qualifications of the personnel in a cost estimating division. Too frequently, the manufacturer considers cost estimating as a non-essential, but in reality, it is a very necessary factor in pre-determining profits.

HANDY ANDY SAYS—

(Continued from page 28)

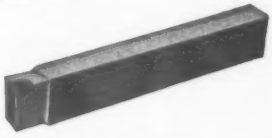
recommend this story because it so poignantly portrays the honest-to-God travail the founders of our country went through to make it the Land of the Free. What they toiled to build, let us dedicate our lives to preserve. We can pass no finer heritage on to our children.

Yours for Progress,
Handy Andy

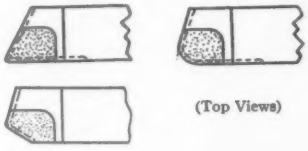
There are now 29,425,000 motor vehicles registered in the United States.

How To Make A Carboloy Tool Do Triple Duty On Small Runs

Low tool inventory and broader use of Carboloy throughout your plant on small runs is possible when you take advantage of the unusual flexibility of Carboloy standard tools. Using rapid grinding procedure now available (Bulletin GM-36) tools may be quickly readjusted as often as desired to meet varied requirements. Thus tool cost is absorbed over *many* jobs instead of just one. For example, take the Style 4 tool shown below.



This Carboloy tool (one of 9 standard styles. Catalog M-37) may be economically reground to numerous shapes required. Three typical adaptations are shown below:—



(Top Views)

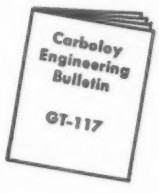
Sheet Metal Draw Dies

The ability of Carboloy cemented carbide dies to produce an unusually fine finish and to hold work within extremely close size limits for long periods of operation is of particular value for sheet metal drawing. This is especially true on high-speed, quantity-production eyelet machines where

every minute of downtime means a production loss up to 300 pieces. Producers of eyelets for shoes, lamp bulb bases, lipstick tubes, charged water cartridges, pencil caps, radio tubes and many other uses are finding Carboloy dies of unusual value. Die sizes now in use for drawing non-ferrous and ferrous stock range from the smallest eyelet die up to 6" I. D.

New Engineering Bulletin Lists Speeds, Feeds, Cuts For All Metals

This new Carboloy Engineering Bulletin differs from ordinary bulletins in that it lists specific *starting* recommendations in addition to a general range of speeds. Also lists specific Carboloy grades for all metals and non-metallics and contains formula for calculating horsepower required. Ask for Bulletin GT-117



Carboloy Masonry Drills

Your maintenance man would like to know about the Carboloy Masonry Drill. Drills concrete, brick, tile, etc., 75% faster than old methods. Ask for leaflet GT-103.

Here Is a Practical Way To *DO IT!*

For those who want to use Carboloy on small, job-lot runs, there is a practical, economical method.

First step is to *forget about Carboloy grade selection!* A large inventory of various grades is unnecessary for small runs. Usually one general purpose grade for steel and one for all other metals and non-metallics will be adequate.

Second step is to select a limited number of general purpose styles and sizes of standard Carboloy tools. Make your selection such that tools can be widely employed in your shop. Flexibility of these tools is demonstrated by the Style 4 tool shown at left. Note the various shapes in which this tool can be ground. All standard tools have this flexibility.

Third step is to apply the simple, rapid Carboloy tool grinding procedure introduced in 1936 and now widely used. With this method, simple adjustments in tool shapes can be rapidly made to prepare a tool for any job selected.

These three simple steps are now successfully followed by a large number of shops having small runs. Once established, you will receive benefits from Carboloy tool use comparable to those of production plants. We'd be glad to help you start to get these benefits.

CARBOLOY COMPANY, INC., 11145 E. Eight Mile Ave., DETROIT, MICH.

CHICAGO • CLEVELAND • NEWARK
PITTSBURGH • PHILADELPHIA
WORCESTER, MASS.

Canadian Distributor:
Canadian General Electric Co., Ltd.,
Toronto, Canada

CARBOLOY

REG U S PAT OFF

TUNGSTEN CARBIDE—TANTALUM CARBIDE—TITANIUM CARBIDE

FOR CUTTING, DRAWING, SHAPING, EXTRUDING METALS AND NON-METALLICS
★ FOR REDUCING WEAR ON EQUIPMENT OR PRODUCTS YOU USE OR MAKE ★

LOOKING AROUND

By Perry Scope

IN the previous issue I promised to give you some suggestions that may be useful in forming your own list of factors in Tool Engineering. Your list should apply to your particular plant and should be used for every tool you design. As a starter, I give you an alphabet for Tool Engineers

to use on any tool.

ADJUSTMENTS—are they simple, easy to make, but positive?

BURRS—will the tool produce them? Remove them?

CAM-LOCKS wherever possible; they save time over studs and nuts.

DAMAGE to the part? to the operator? Protect them? Eliminate strains?

END-FOR-END TRAGEDY? Can the tool be loaded only one way?

FILLETS in every corner possible. (Failures by the thousands on this oversight.)

GAUGING-HOLES — provide them whenever necessary.

HEAVY enough to stay "put"—to eliminate fatigue to the tool and light enough to eliminate fatigue to the operator.

INCREASE that chip room if you can without weakening the tool.

JAM—That which this tool must keep the Boss out of. Are you laughing?

KINKS and do-dads should not be used just because you think them clever.

LUBRICANTS and coolants should be recommended where speed or finish demands.

MECHANICAL or Manual Loading—Decide and state which.

NEATNESS—Appearance is daily becoming more important. Will the appearance of your designs reveal your identity?

OATH OF OPTIMUM—I shall select the combination of conditions to produce the highest quality and output with the lowest overhead to the best of my ability.

PRODUCTION—What production is required? Will it absorb the cost? Power enough?

QUALITY and QUANTITY of part—Will the tool produce both before its life is gone?

REPAIRS—Will points of wear be easily replaceable?

SINTERED CARBIDES—will eliminate wear on important dimensions, cut costs.

TOLERANCES should be no better nor worse than the product's limits and finish demand.

UNIVERSAL in nature so far as possible to design.

VARIATIONS in castings and parts must be provided for.

WABBLE—Is it eliminated, or will the tool or part waltz all over the shop? Waste? Wear? Eliminate them too.

X—The Unknown—someone always uncovers it though—try to be that one.

YOU—The most important part of your world and work. Isn't it? Design your work so that it has your personality.

ZEAL and ZEST tempered with knowledge should be in your work or you arrive at the point of Zero.

Perry Scope

Remember—"By their works ye shall know them."

Conversely—By your works they shall know YOU.

P. S.

Next Issue: Designing Comfortable Tools.

IT'S NEW

(Continued from page 20)

blades tipped with the hard carbide material, Kennametal. The Jack-Lock Wedge locks the blade with extreme rigidity and may be locked and unlocked without pounding, thus avoiding damage to the blades. In addition, the special adjusting screw in back of each blade permits fine and accurate forward adjustment that holds to a minimum the amount of expensive carbide material which must be removed to align all blades when re-

(Continued on page 44)

NEW YORK MEETING

(Continued from page 12)

will tell about punches and dies for small products, punches and dies for large products and many new ideas for all types in between. As wide a variety of applications as possible will be covered.

Tool Engineering Education

Have our educational institutions kept pace with the rapid development of the science of Tool Engineering? The rapid development of this science has made it difficult to cover this subject in regular courses in our institutions of higher learning. In this symposium tentative plans and suggestions will be formulated providing a closer relation with industry and various educational groups.

The field of Tool Engineering has been growing fast, but the source of supply for trained Tool Engineers has lagged far behind. Educational Institutions should recognize this lack in their curriculums and develop proper courses in order that students may enter industry better equipped with "Tools" with which to work. This subject will be handled by Clifford S. Stillwell, Ex. V. Pres. Warner & Swasey Co., outlining Industry's needs. J. W. Barker, Dean, College of Engineering, Columbia University, will describe the possibilities and limitations of our universities to cover this field. B. L. Bowsher, Superintendent of Schools, Toledo, Ohio, will present a plan for covering the fundamentals of Tool Engineering training in our high schools while Thomas P. Orchard of the Technical Evening Classes, Paterson, N. J., will show where the vocational schools fit into this picture. Also Don Flater, Wks. Mgr. Chrysler Div. Chrysler Corp. will lead discussions on this subject.

Annual Meeting

Progress reports, installation of officers and the third and final report of the A.S.T.E. Fact-Finding Committee will be given. Howard Coonley, Pres. Walworth Co., also past president of National Association of Manufacturers will present a message of vital importance to mechanical executives.

Cutting Tools and Materials

Amidst a variety of claims and counter-claims of one type of cutting material against another it seems proper to develop the proper scope of the different materials. This session is offered to promote a better understanding of the proper application of the various cutting materials arriving at their most economical and productive usage. E. S. Chapman, General Works Manager, Chrysler Corporation, Plymouth Division, will present the lead-off paper using the wealth of material which has been gathered at the Plymouth plant. L. C. Gorham, an acknowledged authority on High Speed Steels will present information covering the latest developments in this field. W. G. Robbins, President of Carboloy Company will present the latest developments and applications of the Carbides, and A. H. d'Arcambal of Pratt & Whitney will speak on "High Speed Steel Cutting Tools, Their Selection, Use and Care."

The next issue of THE TOOL ENGINEER will feature the complete program and schedules of events and sessions as well as many other things of interest, as the final preparations are completed to the last detail. We'll be there—we're planning now to attend—and we hope you are, too.

IT'S NEW

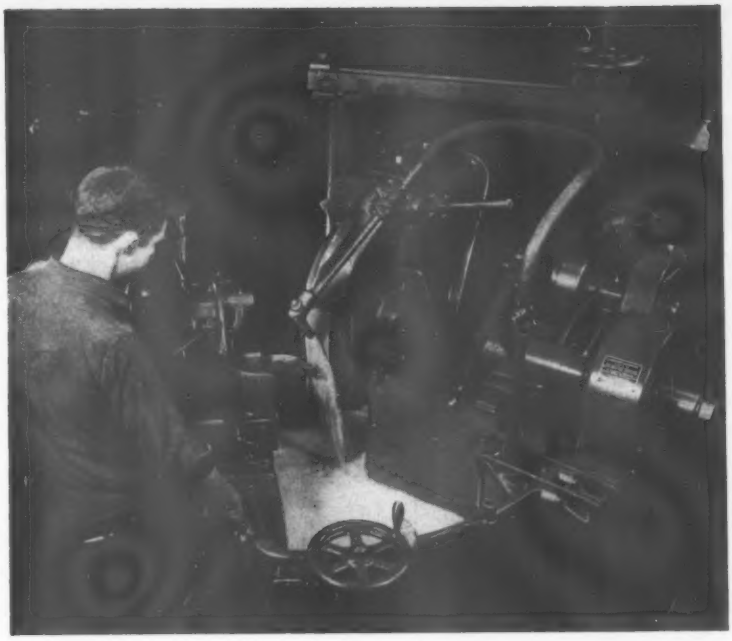
(Continued from page 42)

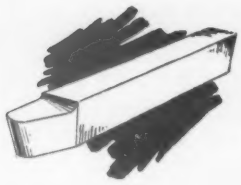
grinding. Blades may be moved forward as little as .002 of an inch. These design features are shown in the eighteen blade facing mill illustrated.

▼ ▼ ▼

The man in the tool crib who has lost his temper and some hide fighting a snarling, twisting, kinking length of band saw stock will welcome a new method of packing this product, adopted by W. O. Barnes Co., Inc., Detroit, Michigan.

Lengths of metal cutting band saw up to 100 feet, in widths ½ in. and under, are now delivered to the customer in a flat carton, with one end of the coil readily accessible. The tool crib attendant, asked for a ten-foot length, holds the carton by the upper left corner in his left hand, pulls the band saw from the small opening in the upper right corner with his right hand.



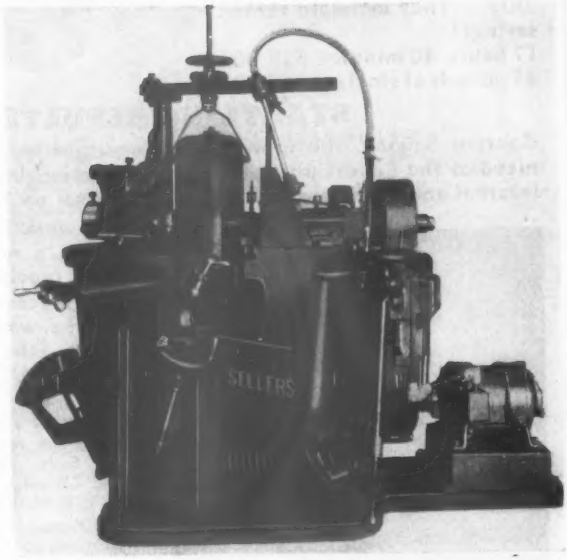


How your tool room attendant can step up production

IN THESE DAYS every productive employee counts — but only while on productive work. Do you know how much of your machinists' time is spent on tool grinding? The figures may surprise you.

Why continue? An expensive machine stands idle . . . production is held up! Yet your tool room attendant can do this job. With a Sellers Tool Grinder, he can grind tools more accurately than the best machinist can by hand . . . and in less time. Less tool steel will be wasted and the tools will last longer and cut better. Your machinist can be kept on the work you are paying him to do — and production will not lag.

If you are looking for a way to save money and keep production at peak, we know you will want more information about Sellers Tool Grinders. Write today.



WILLIAM SELLERS & CO. Incorporated
1626 Hamilton St. - - - Philadelphia, Pa.

FOUNDED SELLERS 1848

Sellers

(Continued from page 19)

chine line" for 6 h.p. is approached. This means that a machine of 8 h.p. cannot be used to its full capacity if a smaller area than that which corresponds to point I (and therefore to the cutting speed formula 1) is chosen, and if a tool life of 60 minutes must be maintained. Therefore the productivity would decrease considerably as will be seen from the chip volume/min. $A \times v$, which decreases

from $0.013 \times 80 \times 12 = 12.5$ cubic in./min. (point I)

to $0.0065 \times 105 \times 12 = 8.2$ cubic in./min. (point R).

Therefore: Increasing the cutting speed and simultaneously decreasing the chip cross sectional area in such a manner that the kind of tool and the tool life is kept constant, is not advisable, due to the fact that the productivity is decreased considerably.

2. Following the tool line in the direction of arrow 2 results in an increase in the chip cross sectional area and a decrease in the cutting speed for a constant tool and tool life.

Here the 10 h.p. line is approached; such a change would result in an overloading of the machine.

Therefore: Decreasing the cutting speed and simultaneously increasing the chip cross sectional area in such a manner that the kind of tool and the tool life is kept constant is not advisable since the machine would be overloaded.

3. Another possibility, viz: following the machine line in the direction of arrow 3 results in an increase in cutting speed, and a decrease of the area A, but here we leave the "tool line" of 60 minutes endurance, and approach the 10 minutes tool line. Since such a short tool life would be uneconomical, the kind of a tool must be changed. Thus, a cemented carbide tool must be used if the cutting speed is increased "along" the machine-line of 8 h.p. between the points I and K. Beyond point K the life of a cemented carbide tool would be less than 1000 minutes, while it is obviously much higher than this in the neighborhood of point I.

An additional point may be brought out here, as to the chip volume and the cutting force. Diminishing the chip cross sectional area from 0.013 (point I) to 0.0065 square inch (point T) and increasing the cutting speed from 80 ft./min. (point I) to 144 ft./min. (point T) results in a decrease of the chip volume per minute from 12.5 cubic in./min. (point I) to 11.2 cubic in./min. (point T). This behavior is due to the aforesaid increase in specific cutting pressure for decreasing chip cross sections. It increases from 246,000 lbs./sq. in. (point I) to 277,000 lbs./in.^{2} (point T).

The cutting force, however, decreases from (see scale at top of Figure 7) 3200 pounds at point I to 1800 pounds at point T. This decrease in the cutting force results in a decrease of the load which is exerted on the work piece, and consequently, in less deflection and higher accuracy.

In spite of the diminution of the chip volume for increasing cutting speeds and decreasing chip cross sectional areas, it is therefore often desirable to use small areas and high cutting speeds according to the direction of arrow 3. This will obviously be at some sacrifice in productivity, but still considerably more advantageous than in the case of following the direction of arrow 1, where the chip volume was reduced to 8.2 cubic in./min. for the same area of chip $A = 0.0065$ square inch.

In addition, the use of high speeds is important for obtaining a smooth finish on the work piece due to the change in the behavior of the "built-up edge"[17] with increasing speeds.

4. Following the machine line in the direction of arrow 4 results in a decrease of the cutting speed and an increase of the chip cross sectional area. Here the tool life would be improved as indicated by approaching the 1000 minutes tool line, and the chip volume would increase also. At point L this would be $0.041 \times 31 \times 12 = 15.3$ cubic in./min. Thus

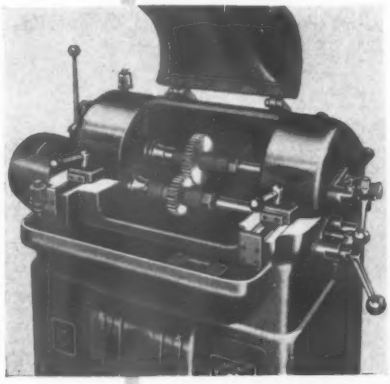
(Continued on page 48)

NEW RED RING MACHINE

FOR SOUND TESTING GEARS

The new Red Ring Sound Testing Machine incorporates a number of improvements to better facilitate its use in the shop and reduce setup time.

The drive spindle is located in the base at a fixed center distance from the motor drive shaft. Consequently belt tension requires no adjustment when center distances are changed.



The driven spindle is located in a sliding head. The movement of this head, which carries a micrometer adjustment, provides the center distance required between driving and driven spindles.

The driven spindle is provided with an improved brake for loading the gears under test.

The sliding head is locked by binder screws equipped with arm and knob—accessible from the outside of the machine, thus eliminating the need for a wrench.

Streamlined base carries recessed compartments for electrical equipment avoiding unsightly control boxes. All units are easily accessible. Four operating speeds are available. A complete range of machines includes units for all capacity requirements.

Sound test your gears in this way before final assembly. Assemble only gears which are within noise tolerances and save the cost of tearing down assemblies subsequently because of noisy gears.

NATIONAL BROACH AND MACHINE CO.

5600 ST. JEAN • DETROIT, MICHIGAN

Patents issued and pending No. 2,044,955

SINGLE POINT TOOLS

(Continued from page 46)

it seems that the use of a low cutting speed in connection with a big chip results in both a better endurance for the same kind of tool and a higher productivity. However, it must be borne in mind that the cutting force increases considerably in this case, for instance from 3200 pounds (point I) to 8000 pounds (point L). The work piece and the lathe bed would therefore be deflected in a considerably higher degree than in the case of point I, and moreover the feed/rev. would be coarse; both resulting in a lower accuracy and poorer finish. This procedure (along arrow 4) is only advisable if roughing cuts are to be taken on stable work pieces.

Therefore: Selection of and changes in the cutting speed as a function of chip cross sectional area, should preferably be made in accordance with the "machine line" and not in accordance with the "tool line." The tool should preferably be adapted to the speed pre-selected in this manner, and not the speed adapted to the kind of tool. Increasing the speed according to the machine line should be accomplished by the use of a higher quality tool and is advisable if the work piece is unstable and if higher finish is desired. It is advisable on the other hand to decrease the speed and increase the area of chip according to the "machine line" in the case of roughing big work pieces.

This "productivity diagram" is considered to be the basic diagram for machining with single point tools. If the general arrangement of this diagram is kept in mind, it will aid greatly in anticipating the most effective combination of the main cutting variables involved.

From the foregoing it can also be derived that the future development of machine tools will follow the same trend as it found in all branches of machinery, viz: the utilization of power by high speeds and low forces. This results as far as the tools are concerned, in the use of high quality tools, and as far as the machines are concerned, in high powered machines of rigid construction and maximum freedom from vibration.

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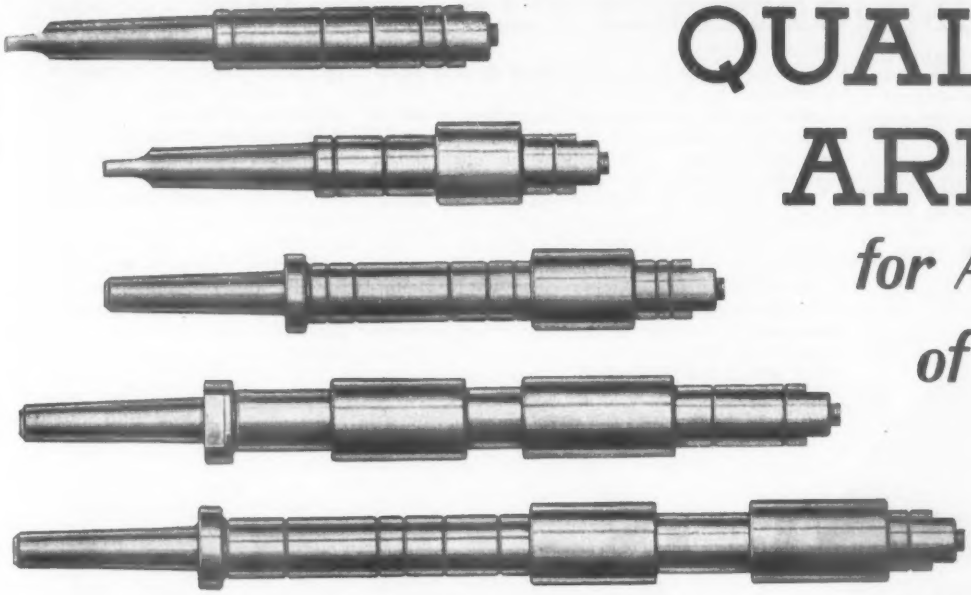
Errata:

Figures 3 and 4 of Part 1 of this article were erroneously interchanged. Text beneath remains as is.

Substitute "n" for "u" in the formula in the third column of page 16.

Text on Figure 1 should read "with cutting fluid," not "no cutting fluid."

MILLING MACHINE ARBORS

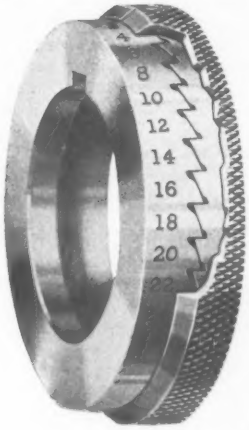


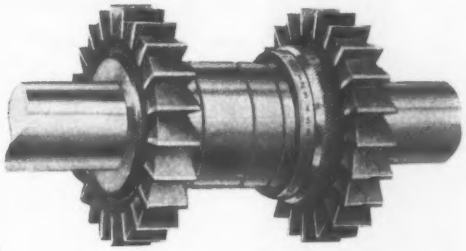
QUALITY ARBORS

for All Makes of Machines

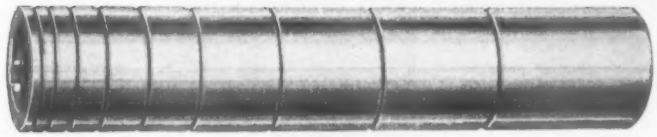
ADJUSTABLE SPACING COLLARS

THEY ELIMINATE THE USE OF THIN SHIMS





Solid Spacing Collars



SCULLY-JONES & CO.

1907 SOUTH ROCKWELL STREET . . . . . CHICAGO, ILLINOIS

HARDENING TO PREVENT DAMAGE

(Continued from Page 16)

the American Society for Metals. This furnace and a crude predecessor have given uniformly successful results hardening production dies. During this period 324 dies and tools have been hardened for shop sections without a single hardening failure or complaint from the production departments using them. In fact these departments report twice the life between grinds previously obtained from the same steels and that no die so hardened has yet been discarded because of wear or breakage.

Although our production departments were entirely satisfied with the work from the laboratory furnace, its design was not well adapted for use in hardening rooms. Based on principles established in our laboratories by Mr. Gier, Westinghouse furnace engineers designed and built a model for production use. This furnace is shown in Figure 7 and is the one which was exhibited at the National Metal Congress in October, 1939, hardening test pieces of No. 3 steel there. Photographs of dies hardened in this furnace or its predecessor are shown in Figure 8.

The preceding furnace nevertheless performed an invaluable service in establishing the principles of bright hardening, and particularly that preheating is unnecessary. Elimination of the preheat chamber in the production model reduced the heated space to a single zone. It was now possible to make the single heating zone accessible only from one end through a gas-tight metal muffle sloping downward from the hot zone. The slope permitted elimination of three of the four doors otherwise necessary, leaving a single door which can be opened at any time without contamination of the gas in the high heat zone.

Work is carried into the furnace on a specially designed light weight tray which shows in Figure 7. By virtue of radiation shields at both ends, a uniform temperature is assured over the working space which is 12 x 17 inches in area, and 4 inches high. The work is evenly supported and not handled with tongs, so there is no danger of distortion by sagging under its own weight while hot. The tray also prevents sudden chilling of the work by direct contact with cold metal when it is drawn into the cooling zone. A single large piece or many small ones can be hardened in one charge.

The work loaded on this tray for hardening is first pushed into the water-jacketed cooling chamber which is a prolongation of the gas-tight metal muffle. Air introduced with the work is then flushed out by normal flow of ammogas and in a few minutes the tray is pushed with a metal rod into the hot zone. After it comes to temperature as indicated by the recording thermocouple or by visual observation through the peep-hole in the door, it may be soaked as long as necessary for best mechanical properties. With this equipment there is no need to compromise between decarburization and soaking time.

After soaking as desired, the tray is pulled back into the cooling chamber where it is left in contact with the protective gas until cold. Obviously, no special skill is required for this hardening operation. So cooling hardens all of the steels listed in Table I to the hardness values given, provided only that the biggest section is not too heavy. The work will come out bright, that is, without tarnish or temper colors, if cold enough to handle when the door is opened. Steels such as Nos. 1 and 3 of Table I are file hard on all surfaces as well as over all sections cut through the hardened steel.

Referring back now to the six principal forms of damage listed in the introduction, one may see whether or not they have been eliminated. They are:

I (a) Oxidation (scaling)
I (b) Decarburization
I (c) Warpage by sagging
II (a) Cracking
II (b) Distortion
II (c) Incomplete hardening

If these forms of damage are reasonably eliminated, the means of elimination can certainly be called "trouble-free hardening."

Of the three detrimental effects on the work occurring while it is at the hardening temperature, I (a), (b) and (c), oxidation has been fully eliminated by use of the highly reducing ammogas and sagging by adequate support of the work. Decarburization is eliminated to the degree that it is not detectable in a 0.070 inch wire of carbon drill rod wire heated at 1850°F. for 1½ hours. If decarburization should be detected in smaller sizes, it can be easily avoided by introducing a small amount of a carburizing gas such as natural gas into the ammogas atmosphere. A carburiz-

(Continued on Page 52)

CUSHMAN ANNOUNCES *The first application of* ELECTROLIMIT GAUGES

TO CONTROL THE ACCURACY OF CHUCK MOUNTINGS

Constantly searching for better methods of inspection and more precise control of accuracy, Cushman Engineers suggested to the Pratt & Whitney Gauge Department that suitable equipment be designed for applying the ultra-sensitive Pratt & Whitney Electrolimit Gauge to chuck inspection.

Such equipment now is being used in our inspection department to assure a new degree of laboratory precision in the mounting diameter and taper dimensions of all chucks for the American Standard and Cam Lock Spindles.

This is the first time Electrolimit Gauges have been applied to Chuck inspection. It is an important addition to the many EXTRA steps Cushman takes to safeguard Chuck accuracy and performance . . . at no extra cost to the user.

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Photographs (under actual working conditions) show how easily and surely the inspector checks direct simultaneous readings for taper and diameter after setting the limit gauge to the master ring gauge (in circle).

CUSHMAN CHUCKS

A WORLD STANDARD *for* PRECISION

HARDENING TO PREVENT DAMAGE

(Continued from Page 50)

ing atmosphere so formed has been used to carburize the surface of dies where the application warranted it. With a special treatment surface hardness values of 67-68 Rc have been obtained on work so carburized. Thus the most detrimental action occurring at hardening temperatures is under complete and simple control.

Among the bad effects occurring during cooling from the hardening temperature, listed under II, cracking is the worst for cracked work is usually a complete loss. Though very difficult shapes having sharp notches have been hardened among the 324 production dies hardened when this is written, none have developed hardening cracks. This observation includes many dies which have been rehardened, some of which had grinding cracks which were not enlarged by rehardening. Figure 5 is a pertinent example of a piece that cracked badly on oil quenching but can and has been hardened with complete safety in the ammogas furnace. In fact the residual stresses which cause cracking are so low in ammogas-hardened dies that they can be used at a higher hardness than permissible with oil quenching, many being used in Westinghouse shops at 63-64 Rc. Evidently then, all trouble from residual stresses is completely eliminated by ammogas hardening.

Distortion is another frequent and disagreeable factor in hardening. A statement of the degree of distortion elimination by ammogas hardening, however, requires a brief review of the major factors influencing the dimensional changes which steel undergoes when hardened. Such a review with illustrative data follows.

All steel increases in volume when it is hardened throughout to values over 60 Rc. This fact has been obscured by loss of metal from oxidation and by directional effects in the dimensional changes. Now that oxidation is eliminated and steels that harden throughout to maximum hardness are used, their true dimensional changes can be determined with ease and has been done.

Selecting two steels widely used in Westinghouse shops, Nos. 1 and 3 of Table I, their dimensional changes on hardening and tempering were observed by Mr. T. H. Gray of the Westinghouse Research Laboratories. His results, to be published in detail later, are shown in Figures 9 and 10. The steel of Figure 9, No. 3, increased its dimensions equally in all directions by 0.0010 inch per inch on hardening in the ammogas atmosphere furnace. This is a maximum value because the steel shrunk uniformly on tempering as shown also in the figure. It applies as well to full size dies, the dimensions of several having been measured before and after hardening.

The dimensional changes of steel No. 1, Figure 10, are more complicated than those of No. 3 because this steel shows a pronounced directional characteristic. Dimensional change in the direction of rolling (length of specimen in this case) is as great as for steel No. 3, but that transverse to the rolling direction (diameter of specimen), is negligible. However, on tempering this steel shrinks in both directions so the net change tempered say to 350°F. is an expansion of 0.0008 inch per inch in rolling direction and shrinkage of 0.0004 inch per inch transverse to that direction. This same effect is found in work cut from large rectangular bars of the same steel and is shown by observations on production dies which are plotted in Figure 10.

It is now clear that hardening in ammogas does not eliminate dimensional changes nor was it expected to do so. The changes, however, are small, consistent and predictable so they may be compensated prior to hardening. Distortion then in the sense of unpredictable dimensional changes is clearly absent as was anticipated from the fact that temperature gradients during cooling for hardening are negligible even in heavy sections.

There still remains the danger of incomplete hardening, that is, failure to

(Continued on Page 54)

Sunnen *Precision* Honing

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4 Operations in 1

1 Corrects errors of out-of-roundness and taper

2 Accurately finishes internal diameters as to size and straightness

3 Produces super-smooth surface finishes

4 Maintains alignment established by previous operations

The modern way to finish internal cylindrical surfaces
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- ✓ It positively corrects errors of out-of-roundness and taper and does it with such simplicity as to astonish even experienced engineers.
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SUNNEN

Sunnen Model "MA" 4-Speed PRECISION HONING MACHINE

HARDENING TO PREVENT DAMAGE

(Continued from Page 52)

reach the maximum value of the steel treated. This danger attends every hardening operation unless the steel composition and quenching medium are carefully selected to match the size and shape of the article to be hardened. Obviously no design of furnace can correct for the mistake of selecting a steel of inadequate hardenability for the job at hand.

The possibility of incomplete hardening is minimized by as complete a statement as possible of size limitations. Such a statement is carried in the last column of Table I which conveys the specific information, for example, that a bar of No. 1 steel 3 inches thick by 6 inches wide, unlimited as to length, reaches maximum hardness on ammogas hardening. This statement means, of course, that any smaller solid block made from the same steel can be so hardened to its maximum value. Also thicker blocks having holes in them may also be fully hardened provided no wall thickness in the length-width plane exceeds 3 inches. If then a steel is selected which will harden fully in the size required, certainly not a difficult task, incomplete hardening is eliminated as a hazard.

Despite all reasonable precautions, hardening failures can still occur. Then it is necessary to find the cause of the trouble in order to correct it. The most common hardening trouble, and also the one most difficult to diagnose, is failure to secure full surface hardness as hardened. This condition may be due only to testing the work while it is still warm from the hardening operation. If, however, a low hardness is found after the work reaches room temperature, there are several possible causes, namely:

(1) Decarburization.
(2) Low hardening temperature.
(3) High hardening temperature (possible only in high carbon steels).
(4) Incomplete hardening.

Identification of the responsible factor requires some detective work, particularly in the absence of metallographic equipment. With the use of a sensitive hardness test, quite definite conclusions can be drawn if the hardness deficiency is pronounced.

To detect decarburization it is sufficient to grind off a few thousandths of surface metal over a small area without heating and retest for hardness. An increase in hardness indicates decarburization. Whether the hardening temperature was too high or too low can be determined by slowly cooling the work to dry ice temperature. If the hardness at room temperature increases materially after this operation, the hardening temperature was too high. No appreciable change in hardness indicates either too low a hardening temperature or incomplete hardening. A hardness test which produces a very small impression can distinguish between these factors. The scatter between individual test values is much less when a low hardness value is caused by too low a hardening temperature than when caused by incomplete hardening.

Failure to secure full hardness with ammogas hardening by a control error entails no serious consequences. The work may safely be rehardened with care in reheating. Even carbon can be restored to a decarburized surface as previously indicated. With reasonable care in hardening, however, the chances of failure are quite remote. In fact the only ammogas hardening failures that our furnace operator can recall are those where the steel submitted for treatment was of radically different composition from that specified. Designation of this hardening method as "trouble-free" is therefore within the bounds of propriety.

W. W. Davidson, Vice President in Charge of Sales of Detroit Rex Products Company, Detroit, Michigan has announced the following promotions effective immediately: H. R. Norgren has been made Assistant General Sales Manager in Charge of Special Accounts; D. E. Williard, Assistant General Sales Manager in Charge of Regions and Branch Offices; and R. A. O'Reilly, Manager of Dry Cleaning Division.

Industrial Relations Committee A.S.T.E.

PERSONAL SERVICE

SITUATIONS WANTED

Several thoroughly experienced tool designers and die designers available. Also checkers, draftsmen and apprentice tool designers. We also have the applications of plant superintendents, production managers, machine shop superintendents, chief tool designers, assistant tool superintendents, process engineers, methods and equipment engineers, production and tool room foremen, and sales engineers, all experienced and capable of filling the position they are seeking. For further information call Tyler 5-0145 or write to American Society of Tool Engineers, 2567 West Grand Boulevard Detroit, Michigan.

SITUATIONS AVAILABLE

Wanted Metal Cutting Tool Engineer for designing and servicing tools, preferably on broaching. Call Tyler 5-0145, or write to A.S.T.E.

Layout Designer with experience on hand screw machines wanted. Also good tool and die makers, with experience on progressive dies and the drawing dies for deep shell work. Also Die Sinkers for hot forge brass work. All for vacancies with well known manufacturer in Connecticut.

Wanted Tool Designers—Board men for jig and fixture designs, capable of making sketches and laying out cams.

Sheet Writers required having a full knowledge of operation analysis sheet writing, and familiar with current methods and machines.

Wanted a good Tool Design Supervisor between 35 and 40 years of age. One that has had some directional experience, and has tact, personality, initiative and plenty of get-up-and-go, that is seeking something of a supervisory nature for employment in New Jersey. For further information call Ty 5-0145 or write to American Society of Tool Engineers, 2567 West Grand Boulevard, Detroit, Michigan.

Manufacturing plant in Hong Kong, China, has opening for toolmaker with technical education or better and experience in designing and making jigs, fixtures and tools for automobile engines and parts. Contact American Society of Tool Engineers, 2567 West Grand Boulevard, Detroit, Michigan, for further information.

TOOL AND DIE ENGINEER wanted, with stamping estimating experience for work in Toledo, Ohio. Must be able to line up operations, estimate production speeds, and design dies and tools necessary for same.

CLASSIFIED ADVERTISEMENTS

CHIEF TOOL DESIGNER desires to make change. Twenty-two years experience in tool, die and machine design. At present responsible for both shop and engineering deparments. Write Box 705, care The Tool Engineer.

SALES ENGINEER, familiar with the Michigan Automotive and Tool trade is interested in selling machinery or equipment requiring technical sales experience. Commission basis. Address Box 707, care The Tool Engineer.

"Learner Class" Trains "Shop Aristocrats"

Thompson Products of Cleveland found the scarcity of production workers has caused them to become the "shop aristocrats." A state-wide search failed to produce a single experienced man, resulting in a "learner class" inaugurated by the company for intensive training of the skilled men needed. The curriculum consists of two hour classes twice a week with 38 hours a week of machine shop with a veteran operator as instructor. For the 42 hours spent each week, the students receive 50 cents per hour. Training is under the supervision of Roy E. Bender who is assisted by August Heinrich, Tool Engineer, and Wellington Stites, automotive expert.

February A. S. T. E. Meetings

BALTIMORE

February 12, 1940—Dinner 7:00 P.M. Technical session 8:00 P.M. Sears Auditorium, North and Harford Avenue.

Speaker: W. R. Breeler, Assistant to Vice-President, Allegheny Ludlum Steel Corporation.

Subject: Development and manufacture of Molybdenum steels, illustrated with movies.

For dinner reservations call Mr. Stanley S. Johns, 806 Evesham Avenue, Baltimore, Maryland. Phone Tuxedo 2127.

BUFFALO

February 15th, 1940—Dinner 6:30 P.M.; Election 7:30 P.M.; Technical Session 8:15 P.M. at the University Club, 546 Delaware Ave., Buffalo, N.Y.

Speaker: J. F. Coneen, Aluminum Company.

Subject: Machining Aluminum and Aluminum Alloys. 1600 ft. sound film and slides.

DAYTON

February 12, 1940—6:30 P.M. Dinner 75c per plate. National Cash Register Co., Dayton, Ohio.

Speaker: Mr. Cogan, Chief Engineer, Nat'l Elec. Welding Mach. Co., Bay City, Mich.

Subject: Precision Welding.

NEW YORK-NEW JERSEY

February 13, 1940—Dinner, 6:30 P.M. Meeting, 8:00 P.M. Hotel Robert Treat, Newark, N. J.

Speaker: F. R. Palmer, Carpenter Steel Co.

Subject: "Better Tools for Industry."

Reservations: Ben Brosheer, Medallion 3-0700.

PEORIA

February 6, 1940—Technical Session, 8:00 P.M. Place to be announced.

Speaker: Mr. Francis J. Trecker, Kearney and Trecker Corp.

Subject: "A New Technique in the Art of Tool and Die Milling."

PHILADELPHIA

February 9, 1940—Dinner 6:30 P.M., Penn. A.C. Two hour floor show—door prizes, interesting exhibits.

Reservations: Paul W. Frankfurter, 4625 Morris St., Germantown, Philadelphia, Pa.

PITTSBURGH

February 9, 1940—Dinner, 6:30 P.M., McCann's Dining room, Ferry and Diamond Streets, Pittsburgh, Pa. meeting 8:00 P.M.

Speaker: T. Ellis, Heald Machine Company.

Subject: "Borizing, Precision Finishing of Surfaces." Display table and slides.

Membership drive of the Pittsburgh Chapter is not making as much progress as your officers expected.

What can you do about it?

ROCHESTER

February 14, 1940—Dinner 6:30 P.M., Todd Union. Technical Meeting 7:45 P.M. Lower Strong Auditorium, University of Rochester, River Campus.

Speaker: John F. Coneen, of the Aluminum Company of America.

Subject: "Machining Aluminum." Accompanied by sound film and lantern slides.

Reservations: By regular membership return card; or non-members phone Stone 2893.

ROCKFORD

February 23—Joint meeting with Rock River Valley Engineering Council at Faust Hotel.

Speaker: A. A. Bates, Mgr. of Mechanical & Metallurgical Dept., Westinghouse Electric & Mfg. Co.

SCHENECTADY

February 12, 1940—8:00 P.M. Rice Hall of the General Electric Company, Schenectady.

Speaker: John F. Coneen, of the Aluminum Company of America.

Subject: "Machining Aluminum."

In addition a 1600 ft. sound motion picture on the aluminum industry.

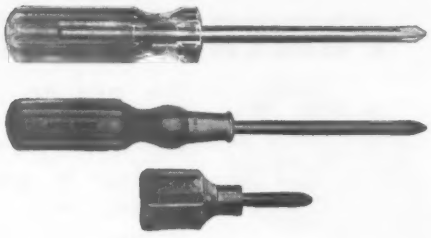
Election of officers will be held at the business meeting to precede the talk. Friends of members are invited.

SOUTH BEND

February 8, 1940—Dinner 7:00 P.M. Technical Session

(Continued on page 61)

APEX-PHILLIPS Hand Drivers for Phillips Screws



Super and General Purpose Drivers

Super Drivers, for self-tapping screws, lower the tool cost per thousand screws driven, and stand up under severe usage. Blades are highly polished and handles are of highest quality hardwood with deep flutes.

"Superloid" Drivers

These are available with the same blades as used on Super and General Purpose Drivers. Handles are made of transparent amber "Superloid" and are break-proof and shock-proof.

Stubby Drivers

Designed especially for close quarters work, and furnished with Super blades or hard-faced Alloy blades. Natural finish wood handles deeply fluted. For sizes 1 and 2 Phillips screws only.

Service Drive Bits

For all makes of assembly Tee handles, extension shanks, speeder handles, ratchets, etc., have ¼", 9/64", ⅜", or ½" square drives.

Hand Brace Bits

Hand Brace Bits for all sizes of Phillips screws with either Super or General Purpose blades. All sizes 4½" in length.

Offset or "L" Drivers

For service and miscellaneous assembly work with body diameters of 9/64", ¼", 5/16" and ⅜"; offsets of 1", 1¼", 1½" and 1¾" respectively.

APEX-Phillips Drivers for hand use are made of special shock-resisting steel, heat-treated for hardness, toughness and wear resistance.
The Super types are recommended for case-hardened, self-tapping screws; the General Purpose for general usage with all types of Phillips screws.
Blades are accurately finished to fit the head of the Phillips screw for greater holding power and faster driving.

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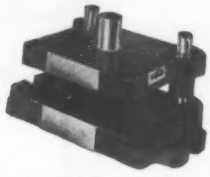

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1. Simplicity and sturdiness adapt this center to heavy duty with extra long life.
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FEBRUARY A.S.T.E. MEETINGS

(Continued from page 58)

8:00 P.M. Bronzewood Room, LaSalle Hotel, South Bend.
Speaker: Dr. Martellotti, Cincinnati Milling Machine Company.
Subject: "Physics of Metal Cutting." Also microscopic moving picture showing action of metal cutting tools.
Reservations: To A. V. Regan, Martin Machine Co., South Bend.

SYRACUSE

February 13, 1940—Dinner, Syracuse Industrial Club.
Speaker: J. F. Coneen of Aluminum Company of America.
Subject: "Machining Aluminum in Automatic Screw Machines."
February 16, 1940—Second Annual Dinner Dance at Drumlins Golf and Country Club, Syracuse.

TOLEDO

February 13, 1940—Place to be announced later.
Speaker: Mr. Tell Berna, President of National Machine Tool Builders Association.
Subject: "The Machine Tool Builder and the World Outlook."

TRI CITY

February 7, 1940—Dinner, 6:30 P.M. LeClair Hotel Ski-Hi Ballroom, Moline.
Speaker: F. J. Trecker, of Kearney & Trecker, Milwaukee.
Subject: "New Technic in the Art of Tool and Die Milling."
Also a picture will be shown by U. S. Electric Motors on "Underground Raindrops."

TWIN CITY

February 9, 1940—Dinner Meeting, 6:30 P.M.
Speaker: E. V. Crane, of the Bliss Company.
Subject: "Plastic Working of Metals."
Election of officers.

ST. LOUIS

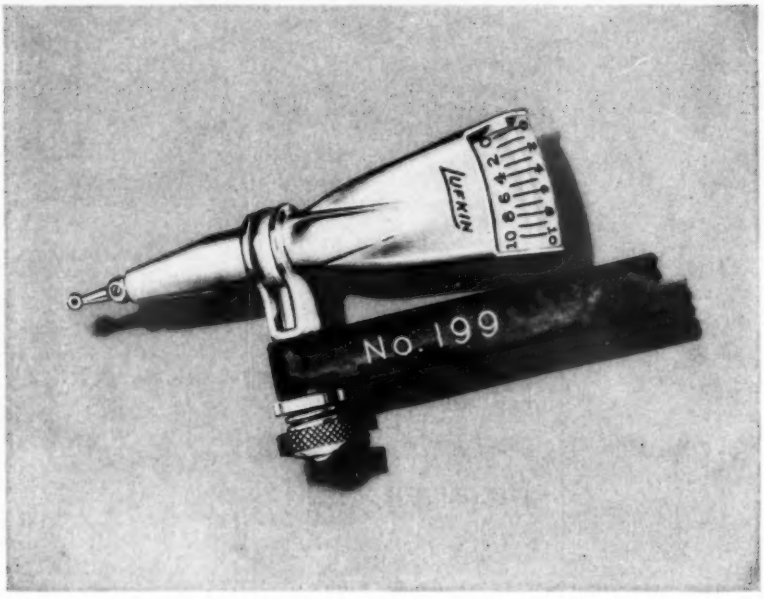
February 8, 1940—Melbourne Hotel, Grand and Lindell Blvd. We will have our National President, James R. Weaver, with us at this meeting.
Technical Speaker: Dr. D. R. Kellogg, of the engineering laboratories, Westinghouse Electric & Manufacturing Co.
Subject: "The Correct Material for the Job."

Turning Back the Pages—

February, 1935 issue—5 years ago—Ivar G. Ecklund . . . appointed chief engineer, Midland Steel Products Company, Detroit. Ray Hesser, Ford Motor Company, has left for Japan . . . Walter Kasturski . . . running a certain comedian a close second in the number of daughters he is "daddy" to. John N. Willys, elected president of Willys-Overland Co. Society's First Annual Ball a Huge Success.

February, 1939 — 1 year ago — International Harvester Company . . . spending 6 million on new equipment . . . Industrial employment in Ohio continues its gain . . . Connecticut ranks third in aircraft production . . . "Tool Engineers, in my opinion, are the backbone of the industrial support of the army."—Lieut. Col. Johnson, Executive for Chicago Ordnance Division . . . A new plastics process by which wings and fusilages of airplanes may be turned out on a mass production basis is announced.

LUFKIN
UNIVERSAL INDICATOR



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It's no longer necessary to use a mirror or resort to awkward positions when working with an Indicator. The Lufkin Universal Indicator has two reading faces—one on the flat side and one on the end so that you can easily take readings direct from the tool, no matter how it is used.

Moreover, the one-piece rotating head is easily set into position. Simply release tension of the clamping device, set the head, and tighten. During this operation the head is frictionally held in place.

Because of its simple construction from the finest materials, the tool's life is greatly lengthened and original accuracy maintained. Send for Precision Tool Catalog No. 7.

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These are quality Lathes, built to industrial standards, with full weight, hand scraped, semi-steel bed, hardened spindles ground all over (even the spindle nose thread is ground) and phosphor bronze bearings. Ideal for tool rooms, machine shops and second operation production work.

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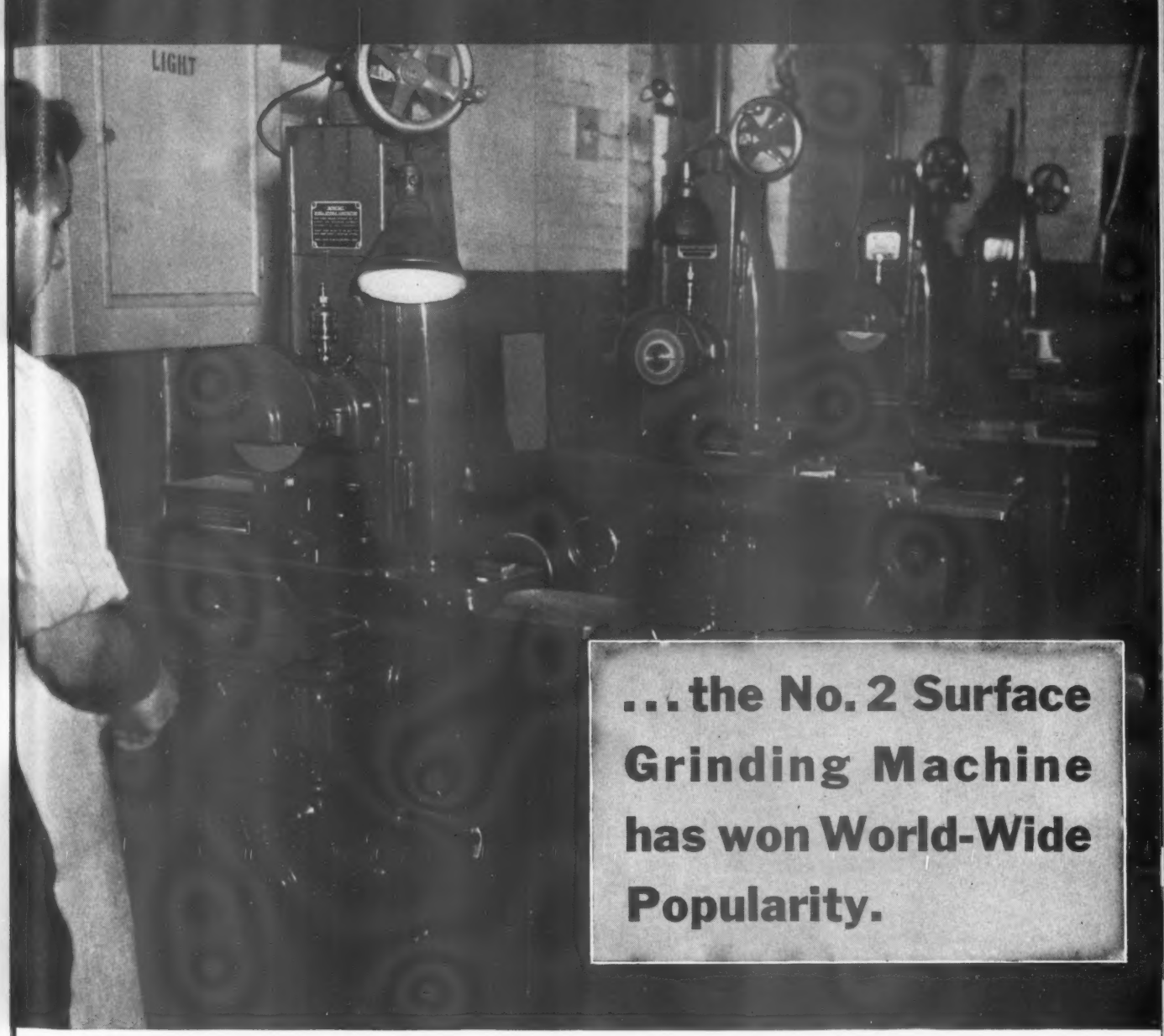

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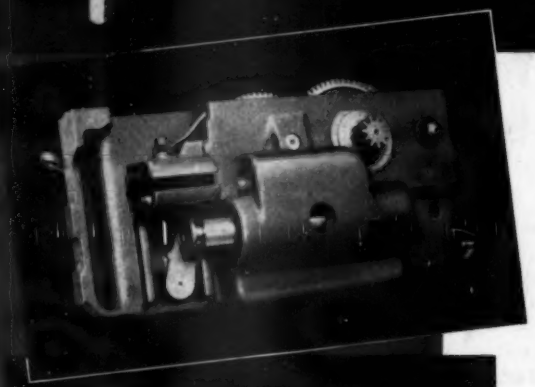

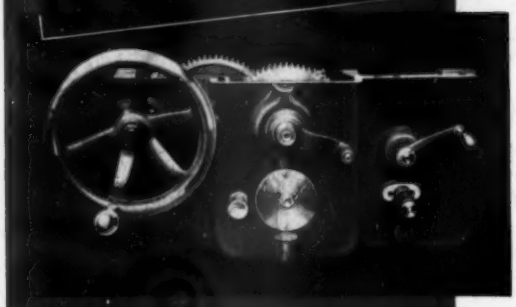

THE LeBLOND POSITIVE JAW FEED CLUTCH

When LeBlond revolutionized apron operation by the positive jaw feed clutch—the big headache of friction feeds was cured. • This positively powerful—powerfully positive clutch spelled the end of slipping, sticking—trouble-making friction feeds. It marked the beginning of a new ease in lathe operation—new precision—new power—no more spoiled work or wrecked machines. • And just one lever controls this smooth, constant, powerful feed—both longitudinal and cross—just one lever—which also releases the apron gears when engaging the lead screw. In addition, an automatic stop provides full protection to the lathe. • Simple—Positive—Powerful—the positive jaw feed clutch is one among many features that assure outstanding performance—in Lathes by LeBlond.

THE R. K. LeBLOND MACHINE TOOL CO.

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